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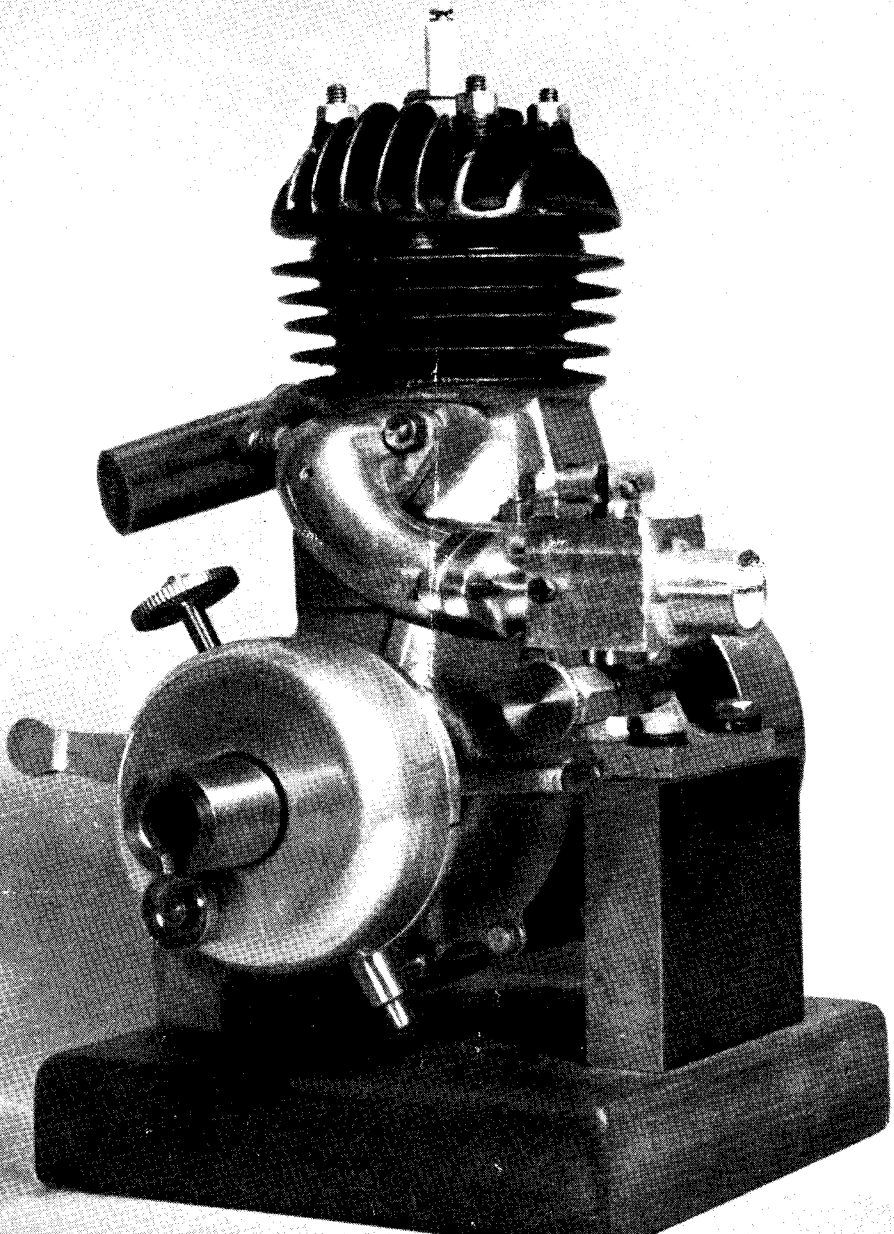


The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

2ND FEBRUARY 1950

VOL. 102 NO. 2541

SMOKE RINGS

Our Cover Picture

● THIS PHOTOGRAPH shows a cylinder-level view of the "Phoenix" 15-c.c. two-stroke engine now being described in these pages. This type of engine represents a departure from the usual type of small i.c. engine, which is intended only for comparatively short periods of running, and has only a narrow latitude of speed control. The "Phoenix" engine is intended for running continuously for long periods, and is capable of a wide range of control by manipulation of the throttle lever alone. It has unusually large bearing surfaces and the general design is robust and conducive to long wear. Other features include the enclosed contact-breaker, which utilises standard automobile components. A good many readers have expressed interest in the construction of this engine, which is well suited for the beginner with limited workshop equipment, and is adaptable to many model engineering purposes when completed.

Knowing the Answers

● MANY READERS of THE MODEL ENGINEER have told us that its usefulness is by no means limited to instructions on how to make models and use tools in the home workshop. On many occasions, we have received glowing testimonials to the value of the subject matter of THE MODEL ENGINEER in professional engineering, and a recent letter from a reader tells how knowledge gained from our pages helped him recently to get a job. He states "I was shown around the works by the planning manager undergoing a sort of quiz to see how much I knew. I thought to myself afterwards, as probably many other people have done: 'Thank goodness I read THE MODEL ENGINEER!' I can honestly say that about half my answers were based on knowledge gleaned from 'ours'."

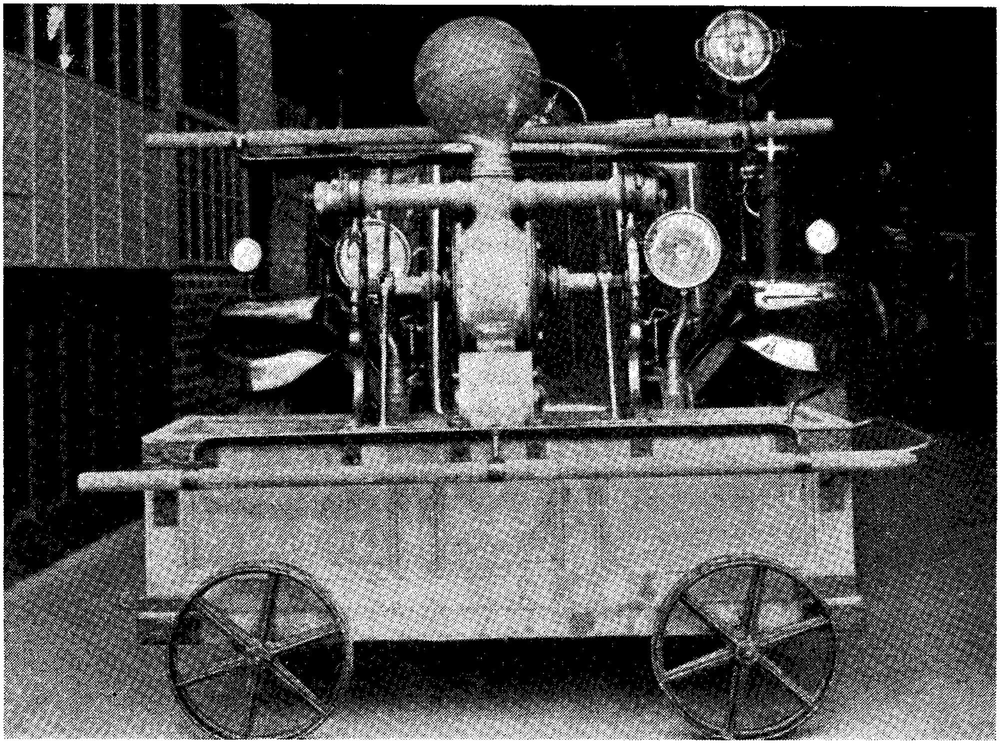
Orders, Please!

● LAMEDOS INDUSTRIES LTD., of Eton, Bucks, who placed on the market, about twelve months ago, some drawings for an attractive toy steam-roller, have requested us to help them in an unfortunate predicament. A recent fire at their works has caused the loss of not only the original drawings and stock of blueprints of the roller but also all records of a number of unfulfilled orders for prints. We understand, however, that new drawings are now available, and any reader who may be waiting for the completion of his order for prints is requested to get into touch with the firm as soon as possible.

Bramah's Fire-engine

● THE RECENT article on Joseph Bramah, by Mr. W. J. Hughes, has brought in several letters of appreciation. One of these came from Mr. R. S. Atkinson, F.R.A.S., hon. secretary of the Barnsley Naturalist and Scientific Society, who, after expressing particular pleasure in the article, writes : "The library of this society contains the original manuscripts of Joseph Wilkinson's book, *Worthies of Barnsley*, which contains a very detailed life-story of the great inventor, the result of much investigation by the author. The book contains no portrait, so I was more than pleased to see the one you have published, as it is the first I have seen.

"As regards the fire-engine, it is now housed in the museum here, and the photograph will give you an idea of its appearance."



We reproduce the photograph on this page, because we think that many readers will find in it as much interest as we did. Certainly, when we are next in Barnsley, we shall visit the museum to inspect this most interesting of relics.

The Destructive Locomotive

● MR. E. G. HOBSON, of Weymouth, has written to question the accuracy of "L.B.S.C.'s" recent statement that the invention of the railway locomotive is "the only one that has never been used for purposes of bloodshed and destruction." Mr. Hobson points out that armoured locomotives and trains have been used in every major conflict from the American Civil War downwards. In that war, they caused some terrible havoc, being the "tanks" of their day. In the Chinese Nationalist wars, armoured trains swept across the country ; in the Russian Revolution, both sides used them, and in the 1914-1918 war, huge railway guns were used by both France and Germany, with three or four engines pushing to take the recoil.

Mr. Hobson concludes his letter with the comment : "There is, unfortunately, *no* invention that cannot be used in the wrong way somehow or other, and our old friend the railway locomotive is no exception."

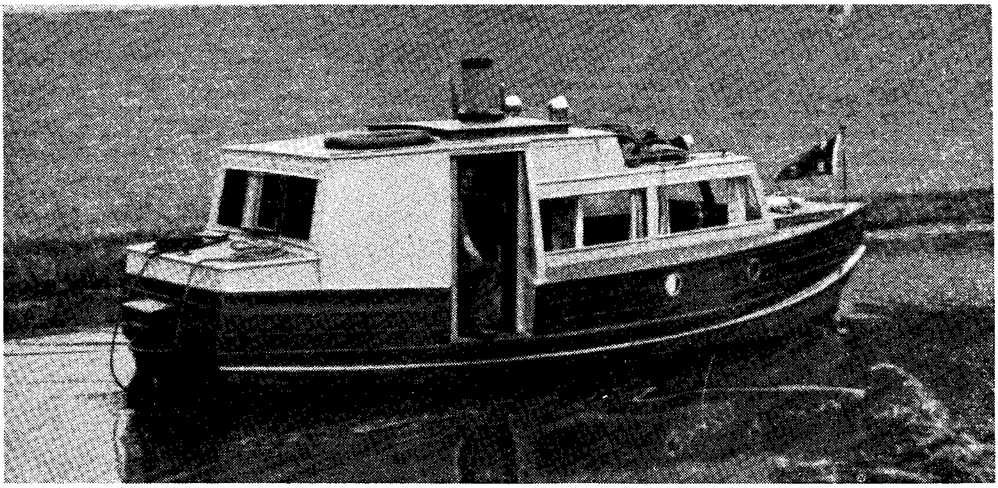
When we see it put that way, of course, we have to agree with the statement ; but, perhaps, it is not too much to claim that the grand total of the railway locomotive's acts of agression and destruction is less than that of any other invention which has, so far, been applied to such grievous purposes. In its legitimate sphere, the locomotive's "black" record is insignificant when compared with the good it has done.

The Kodak Society's Exhibition, 1950

● THE KODAK Recreation Society of Experimental Engineers and Craftsmen has announced that its next open exhibition will be held at the Kodak Hall, Wealdstone, Middlesex, on Saturday and Sunday, April 1st and 2nd, 1950. Further particulars can be had from Mr. G. G. Corder, Hon. Exhibition Organiser, K.S.E.E.C., Kodak Hall, Wealdstone, Middx.

A Small Marine Steam Plant

by S. Bentley



"*Viking*" *under way*

THIS marine power plant is, perhaps, rather large to be described as model engineering, but there may be sufficient model engineers interested to justify its inclusion in this journal.

The decision to install steam in my 20-ft. launch was made before the outbreak of the late war, mainly because I am a steam enthusiast, and apart from the fact that the operation of full-size steam engines brings me my daily bread. During the early days of the war, the boat which was petrol-driven, was laid up in common with all other craft on the inland waterways, due to the cessation of petrol supplies, and this brought the steam installation into being sooner than would otherwise have been the case.

The Davis Engine

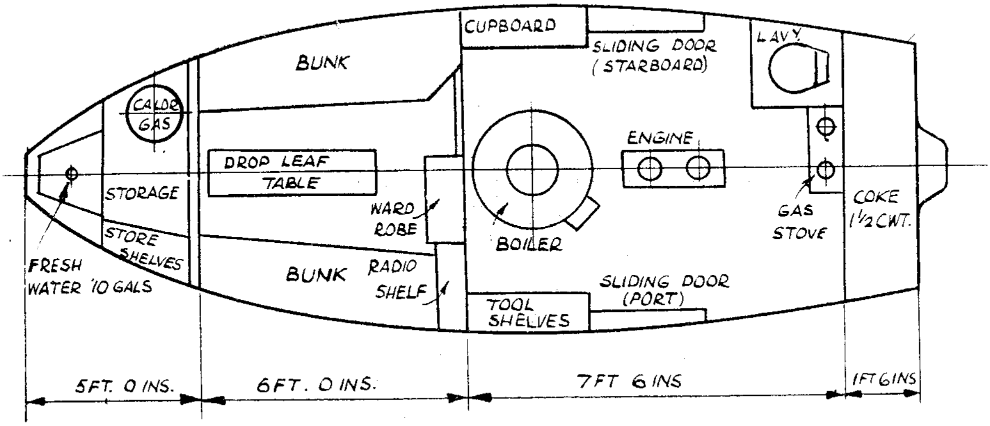
A second-hand steam launch engine in fair condition was obtained, with two cylinders $3\frac{1}{2}$ in. bore $\times$ $4\frac{1}{2}$ in. stroke, jacketed with live steam, and fitted with link motion. This engine was originally built by the Davis Engineering Co. of Abingdon, Berks, and came on to the market when the launch in which it was installed was destroyed by enemy air action, and the engine was about the only sound thing to be salvaged from the wreck.

I purchased a boiler, originally built for a small workshop by T. Goodhand of Gillingham, an old established firm who have advertised in THE MODEL ENGINEER ever since I can remember, which came up for sale due to the closure of this workshop for the duration Although it is a trifle on the small side for this engine, it has proved itself capable, when carefully fired, of supplying all the steam the engine can use, thus proving the soundness of the saying that it is the amount of heat applied and not the area of the heating surface that is important. Boiler dimensions are 3 ft. 6 in. in height, 20 in. diameter with twelve 2-in. fire tubes. Working pressure is 80 lb. and it is injector fed.

Amongst the older motor boat owners were some who had dabbled in steam in their early days, and their comments were that so small a boiler would not steam the boat to the end of the landing stage. However, I thought differently, but at the time said nothing—the question had to be proved.

Enter the Steam Engine

The engine was thoroughly overhauled and during the winter of 1944-45, the petrol engine was removed and sold, and the steam engine and boiler installed. The drawing gives the layout of the machinery in the boat, and the accommodation. All was ready for a trial in the spring of 1945, and on a fine Sunday evening, steam was raised for the first time, and all joints proving steam tight, mooring trials were made, and as everything seemed satisfactory, a full power steam trial under way was decided on. By this time, of course, it was evident that we were ready for a demonstration and the internal combustion "wallahs" proceeded to gather round to watch the fun. The time was about 6 p.m., safety-valve just on the sizzle, boiler full, firebox full and the damper nearly closed. The mooring



Plan showing arrangement of machinery and accommodation on the steam launch "Viking"

ropes were cast off, reversing lever put over to astern, throttle opened slightly and the boat backed out from the berth without a sound. Out in mid-stream we stopped; links were put over to ahead, throttle and damper opened, and we were soon off. As soon as the boat appeared to be getting into her stride, the valve-gear was notched up as far as it seemed prudent, the throttle was opened wide, a few shovelfuls of coke were put on, and we sat back to enjoy a run where conversation could be carried out without having to shout to make oneself heard six feet away.

Lifting the Davis engine into the "Viking"

The first mile was checked off at 11½ minutes. Steam pressure at this time was steady at 75 lb. despite the fact of a Bassett-Lowke No. 2 injector feeding steadily; these injectors by the way, are about the best of anything I have seen for small boiler feeding, and this one rated at 20 g.p.h. was just gaining on the water-level. Firing lightly at intervals, steam pressure could be held between 70 and 80 lb. without difficulty. The trial trip ended about 7 p.m., having covered in a round trip 5 miles—not bad going for a start.

During the four seasons the boat has been steam driven, about 800 miles have been covered up and down the Leeds and Liverpool Canal. I think I can say, that the bogey "steam and cleanliness cannot be had together" has been well and truly laid, as the *Viking* and her crew finish a run as clean and tidy as they were on starting.

Surplus Aircraft Materials

We have received from Messrs. K. R. Whiston, 8, Watford Bridge Road, New Mills, near Stockport, their latest list describing a very wide variety of surplus apparatus and components of a type useful for model engineering purposes. It includes bolts, nuts and screws in steel and light alloy in B.S.F. and B.A. sizes, rivets in light alloy and steel, also a range of electrical components and apparatus, and mechanical assemblies, such as gearing. These goods are supplied on special terms to members of model engineering clubs. This list, together with order form, is obtainable from the above address on receipt of a stamped addressed envelope.

*A Battery-Driven Electric Clock

by C. R. Jones

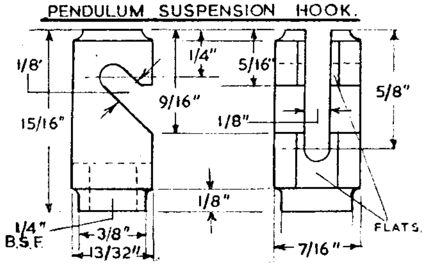
THE trigger block was then tried in the contact assembly, and was found to slide sweetly in the trough, and could be adjusted for position by means of the stud passing through the slot previously mentioned, and secured by the nut and washer.

Pendulum Suspension Hook

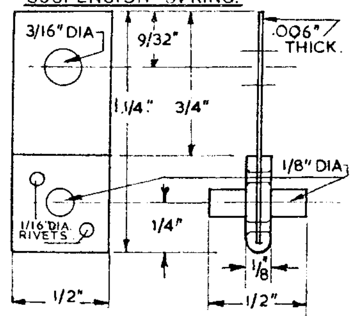
This was turned up from brass rod to the dimensions shown, and was drilled and tapped $\frac{1}{4}$-in. B.S.F. while still in the lathe, for attachment to the pendulum rod.

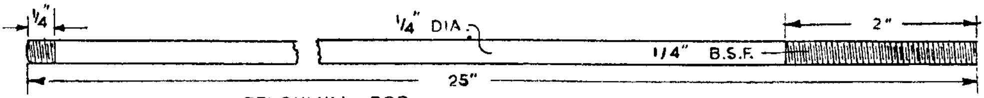
The slots were afterwards drilled, sawn, and filed out, care being taken to make these nice and true.

PENDULUM SUSPENSION HOOK.



SUSPENSION SPRING.





PENDULUM ROD.

Suspension Spring

A piece of the 0.006-in. feeler blade was used for this, and the brass cheeks were made from one piece of brass just over $\frac{1}{16}$ in. in thickness, which was bent over a slightly thicker piece of material than the feeler blade. This was then filed up to size on the outside edges, and the holes for the rivets and the $\frac{1}{8}$ in. diameter pin, marked off and drilled, the hole for the pin being drilled with a No. 31 drill.

The interleaving material was then removed and the end of feeler blade inserted in its place. It was squeezed up tightly in the vice, using some protection to prevent it being marked by the vice jaws.

The holes for the rivets, and the pin were then punched through, using the brass part as its own jig, the same punch being used for the $\frac{1}{16}$-in. holes, and a punch was made from a piece of $\frac{1}{8}$ in. diameter silver-steel, eased down, for making the No. 31 hole.

The $\frac{1}{16}$-in. holes were then slightly countersunk, and using $\frac{1}{16}$ in. diameter wire for the rivets, the whole was carefully riveted together. After this, the sides of the brass part were carefully filed up to be a good fit in the slot in the pendulum suspension hook.

A silver-steel pin $\frac{1}{8}$ in. in diameter, $\frac{1}{2}$ in. long, and slightly tapered on the end was then driven in.

The feeler blade was then cut to length, and using the jig made for the contact assembly spring, the $\frac{3}{16}$-in. hole was punched in the correct position.

The Pendulum Rod

This was a length of mild-steel $\frac{1}{4}$ in. in diameter by 25 in. in length, and was carefully threaded at the top end, $\frac{1}{4}$ in. B.S.F. for a length of $\frac{1}{4}$ in., and at the lower end for a distance of 2 in.

It was then polished and was screwed tightly into the hole in the pendulum suspension hook.

"Invar" would be a great improvement for the pendulum rod should this be obtainable.

Trigger Support

Brass rod $\frac{3}{8}$ in. square was used for this, which was made to the dimensions shown on the drawings, the $\frac{1}{4}$ in. diameter hole being drilled and reamed a good fit on pendulum rod, and the end then rounded off.

It was set up in the four-jaw chuck and the forward end turned down to the correct dimensions and length. It was then drilled, and a short length of 3/32 in. diameter silver-steel was pressed in, the end of which was drilled

**Continued from page 102, "M.E.," January 26, 1950.*

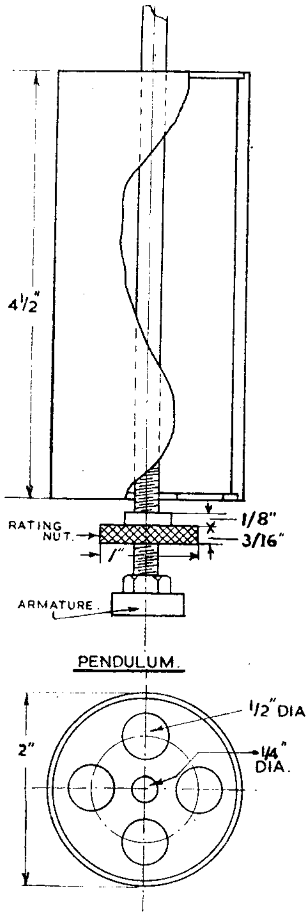
diametrically 1/32 in. diameter, for a small split pin to retain the trigger in position.

The rounded end was then split with a fine hacksaw, drilled and tapped, and provided with a brass set-screw for clamping purposes.

Trigger

The brass portion of this was cut and filed up to the dimensions shown, and was drilled to be a good fit on the pin of the trigger support.

It was slit where shown to take a piece of softened hacksaw blade, and this was secured in



position by means of a $\frac{1}{16}$ in. diameter rivet, the lower end being sharpened to a chisel edge. This end was then hardened and polished, the trigger was fitted to the trigger support, and a split pin inserted.

Great care was taken to see that the trigger was able to swing quite freely, without undue shake, and *without* any oil.

(Since writing the above the writer has shortened the length of the trigger by $\frac{1}{8}$ in. which seems to be a great improvement.)

Pendulum Bob

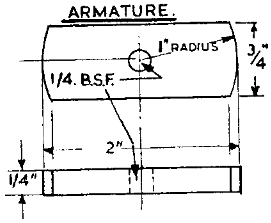
This was made from a piece of steel tubing 2 in. outside diameter, and was turned up true on the ends, finishing to $4\frac{1}{2}$ in. in length. It was then recessed to a depth of $\frac{1}{16}$ in. for about half its thickness, and two washers $\frac{1}{16}$ in. thick were turned up a good fit in these recesses, the edges of washers being slightly tapered. They were drilled centrally in the lathe to $\frac{1}{4}$ in. diameter, and the lower one had four $\frac{1}{2}$ in. diameter holes drilled where shown.

These washers were then placed in position, and the edges of the tube peined over them with a light hammer.

The case of the pendulum bob was now ready for filling with lead, and as all odd pieces had been collected for some time, enough was available for this purpose.

The Bob

A piece of $\frac{1}{4}$ in. diameter steel rod that was well rusted (but not deeply pitted) was placed through the centre of the bob, which was placed bottom upwards in a box of sand. Sufficient lead was heated up, skimmed off and poured through the $\frac{1}{2}$-in. holes, until four globules of lead protruded from them. It was then left to cool, and when cool, the $\frac{1}{4}$-in. steel was removed, and came away easily, the bob being then set up in the lathe, and the surplus lead turned off,



after which the bob was cleaned up all over for subsequent cellulosing.

Rating-Nut

This was turned up from brass to the dimensions shown and needs no special comment.

Armature

The armature was made from a piece of $\frac{3}{4}$ in. by $\frac{1}{4}$ in. flat mild-steel, which was drilled and tapped in the centre, and then put on a threaded mandrel, and the ends skimmed up to a 2 in. diameter circle.

At the same setting a light cut was taken over the surface, which portion would face the magnet poles later.

Magnet Assembly

The bracket was made up to the dimensions shown on the drawings, and the two pieces welded together where shown. The slots for fixing to the baseboard were drilled and filed out, and the holes drilled for magnet cores.

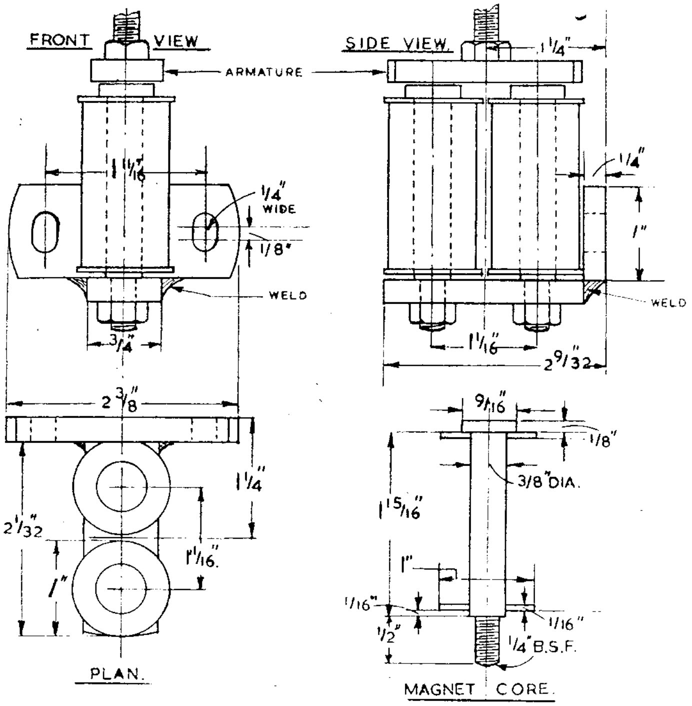
The magnet cores were turned up from mild-steel bolts $\frac{3}{8}$ in. in diameter, the heads being turned down to $\frac{9}{16}$ in. in diameter by $\frac{1}{8}$ in. in thickness. The lower ends were turned to $\frac{1}{4}$ in. diameter, threaded with a $\frac{1}{4}$-in. B.S.F. thread, and provided with two nuts.

The bracket, cores, and armature, were then heated, and kept at red heat for some while, and were then placed in a large tin of asbestos meal, and allowed to cool down slowly.

In the meantime, four brass washers were turned up from $\frac{1}{16}$-in. thick brass, to form the bobbins.

When cool, the bracket was cleaned up, also the cores, after which the brass discs were then carefully sweated on the cores in the positions shown. The lower disc on the rear magnet core, had to have a small flat filed on the rear side to clear the bracket where shown.

Four brown paper discs, the same size as the brass ones, were made and stuck on the insides of them, and a couple of layers of brown paper were stuck carefully over the cores themselves, for insulation purposes.



DETAILS OF MAGNET ASSEMBLY.

The magnet cores were then wound with wire, which came off one of the old plug-in coils used in early wireless days, as no other could be obtained at the time, and measured 0.0164 in. in diameter, and appeared to be double cotton covered and 27-gauge.

The cores were mounted in a hand drill, held in the vice, by gripping the threaded portion in the chuck, and great care was taken to get the layers on evenly, both being wound in the same direction, and both being filled to a diameter of about $\frac{7}{8}$ in.

The finishing ends were fastened with thread, and the windings were given several coats of shellac varnish and put aside to dry.

When dry the magnet was assembled, the finishing end of one coil being connected to the start of the other, and the two outer ends provided with short lengths of Systoflex sleeving. The total resistance of coils measured $6\frac{1}{2}$ ohms.

First Tests

All the parts of the pendulum motor now being completed, it was decided to get it running, and an odd piece of board was looked out about 2 ft. 6 in. long by 6 in. wide, to act as a temporary baseboard. This was securely screwed to the wall, using "Rawlplugs" and suitable woodscrews, and the main frame was secured at the top with a couple of woodscrews.

Before fixing the main frame, a short length of wire was connected under the fixing screw of insulated pillar (*B*) and also another length under the fixing screw of pillar (*C*).

The suspension spring had been placed in position, between the cheeks of suspension bracket, care being taken to see it was gripped true and vertically.

Now the trigger support was slipped on to the pendulum rod and placed in its approximate position, the pendulum bob being threaded on and secured by the rating nut, and being set so that its centre was about 1 ft. $10\frac{1}{2}$ in. from the underside of the suspension bracket.

A $\frac{1}{4}$-in. B.S.F. nut was threaded on and the armature screwed on flush with end of pendulum rod.

The pendulum rod was then passed behind contact assembly and carefully hung on pin on suspension spring.

Great care was taken to see that the armature was locked in position by its locking nut, at right angles to the baseboard. The magnet assembly was now secured to the baseboard by means of woodscrews and washers, directly under the armature (using the pendulum as a plumb-bob) with about 0.030 in. clearance between armature and magnet poles. Note: this is only approximate. The trigger block was adjusted so that the vee-groove in the top surface of the trigger block was just about in line with the left-hand edge of pendulum rod, when pendulum was stationary.

Contact assembly was adjusted to assume a horizontal position by means of the screw and $\frac{1}{8}$-in. pin in pillar (*A*). The adjustable contact was arranged so that the gap between the contacts was about 0.010 in.

The trigger support was adjusted so that with the pendulum to the left, and the sharpened

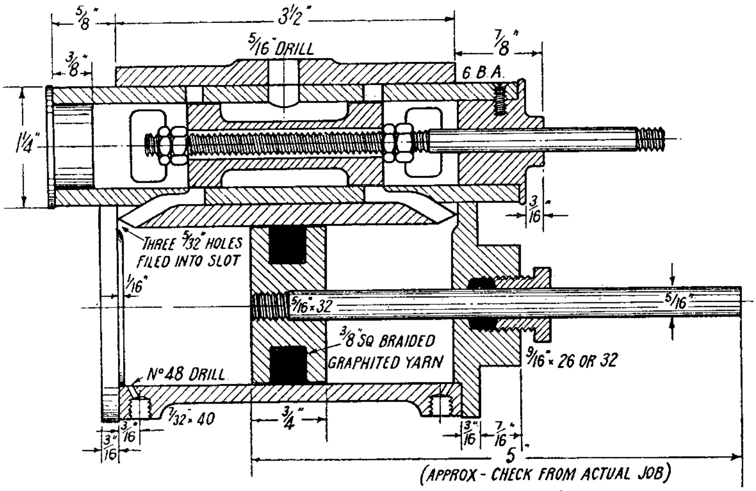
(*Continued on page* 145)

Cylinders for 5-in. Gauge "Doris"

by "L.B.S.C."

BETTER late than never! At long last I have been able to get out the drawings and details for a pair of genuine "Curly" cylinders suitable for a 5-in. gauge edition of *Doris*, and here they are. As most of the machining and fitting-up is precisely the same as those described for the $3\frac{1}{2}$-in. gauge engine, there is no need to go through all the whole ritual again; so if I just run through the itinerary with a few comments, even a beginner should be able to make a "do" of them. The cylinders are of correct piston-valve type, and the bore and stroke are practically "scale," viz., $1\frac{11}{16}$ in. bore by $2\frac{1}{2}$ in. stroke; the piston-valves are $\frac{7}{8}$ in. diameter, which is near enough to the 10 in. of the original. The valve travel is slightly longer, and the ports wider than the full-size equivalent—eh? Oh, never you mind why; that is just one of the little items that make locomotives built to my instructions, do more than I ever claim for them. "A little trick of the trade," as George Robey, of eyebrow fame, would have remarked; I've built no end of a lot of engines, and experience still teaches. The overall dimensions of the cylinders are a little bigger than full-size equivalent, as we have to use thicker metal and wider pistons, for strength and efficiency; but there isn't sufficient "outsize" to be apparent.

If a big faceplate is available, and the lathe used has a decent sized-gap, the method of machining described for the $3\frac{1}{2}$-in. cylinders may be followed with advantage; but if cylinder and angle-plate won't clear the lathe bed, other means must be adopted for the boring job. If you have a set of faceplate dogs, the cylinder casting could be attached, by their aid, to a faceplate of only 6 in. diameter, and would just clear the bed of a $3\frac{1}{8}$-in. centre lathe. Our younger readers probably won't know what faceplate dogs are; well, they formed the old craftsman's method of using his faceplate as a universal chuck. They were merely rectangular blocks of steel, with a stud in one of the facets, by which they were attached to the faceplate; the stud went through the faceplate slot, and was nutted at the back. A set-screw went through each block, at right-angles to the stud; the four blocks were bolted to the faceplate, close to the casting, or whatever was being operated on, and the set-screws in each block run up tightly against it, holding it securely. In the present instance, a piece of wood should be placed between cylinder-block and faceplate, so that the boring-tool can go clean through.



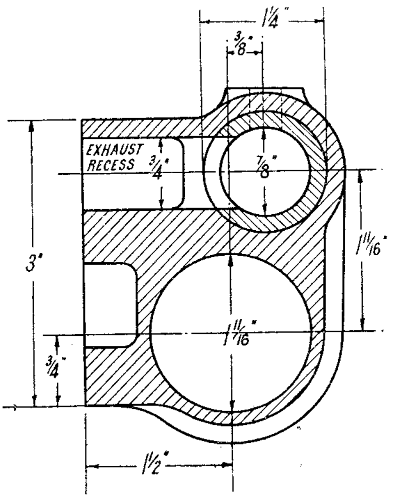
Section of cylinder

On a very big lathe, the casting could be held in the four-jaw chuck; but personally I prefer the angle-plate method, because the angle-plate can be shifted bodily on the faceplate when the main bore is finished, and the steamchest bore set truly for machining; and then both bores cannot help being parallel. On a small lathe, the faceplate probably won't be able to carry the casting at all; and in that case, the only alternative is to bolt the casting to the saddle, with a bar across its back, and a bolt at each end of the bar, as described for angle-plate mounting. Have the corehole, or the centre of the marked circle, as the case may be, at centre height, and the casting parallel with the lathe bed. Then the bores can be machined out with a short boring-tool mounted in a stout piece of bar between centres. The bar

passes through the corehole, the cut is put on by regulating the amount of boring-tool projecting from the bar, and the casting is traversed over the revolving tool by operating the lead-screw either by the self-act, or by hand. If a stiff bar is used, a very good and true bore may be obtained in quite a big cylinder, even on a small rocky lathe. The whole set-up has been illustrated more than once in these notes.

Ports, Passages and Liners

After facing off each end of the cylinder casting,



Section through exhaust port

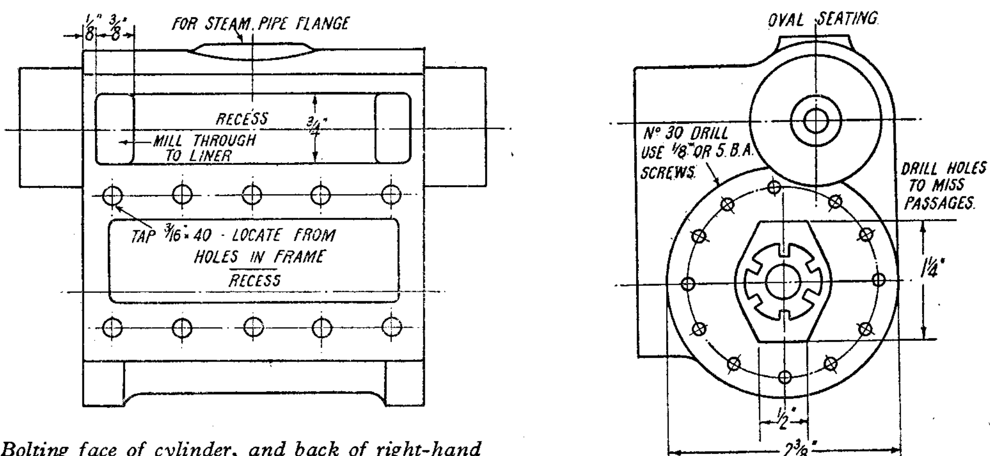
which had best be done on a mandrel between centres, if the lathe is small and light, the passageways at each end may be formed, as described for the $3\frac{1}{2}$-in. gauge engine. Drill three 5/32-in. holes close together, direct from the lip of the main bore, into the steamchest bore (see longitudinal section) and run them into a slot with a rat-tail file. This will pass all the steam needed for any condition of service, without being big enough to cause waste. Bevel off as shown, to allow steam free movement between passages and bore.

The liners can be bored and reamed, with the casting held in the three-jaw chuck, the ends being faced off at the same time. They should be mounted on a mandrel between centres, for turning the outside. Before doing the job, put a bit of rod between centres, about the same length and take a very light cut over it, to see if the lathe turns parallel. If the ends, when tested with a " mike," are less than a thousandth of an inch different in diameter, it will be all right. If more, adjust tailstock, and ditto repeato until O.K. Turn the liner to about 1/64 in. over finished size ; then turn $\frac{1}{8}$ in. of one end of the liner to a very tight push fit in the steamchest bore. Move the cross-slide handle back half a turn, then advance again until within half a division of the original setting. If the cross-slide has no " mike " collar, you'll have to judge by the position of the handle. If another final cut is taken with the slide-rest set in this position, the liner will be a press fit. Note—especially beginners—that the press fit of a liner in a cylinder doesn't have to be a " hydraulic-press " fit, like a wheel on its axle, or the parts of a built-up crank axle. If it is just tight enough to prevent any movement, and at the same time steamtight, that is all that is needed.

The port grooves in the liners can be made with a $\frac{3}{16}$-in. parting-tool, whilst the liner is still on the mandrel ; if slow speed is used, there won't be any chattering. Make them a full $\frac{1}{16}$ in. deep, and have the spacing about right ; then cut away part of the liner wall between the sides of the grooves, and file away a bit at the bottom, as shown, to connect up with the passages in the cylinder casting. Ways and means of doing these jobs were fully explained when describing *Doris* in $3\frac{1}{2}$-in. gauge. The steam inlet, and the " entrances to the way out," are formed after the liners have been squeezed into the cylinders.

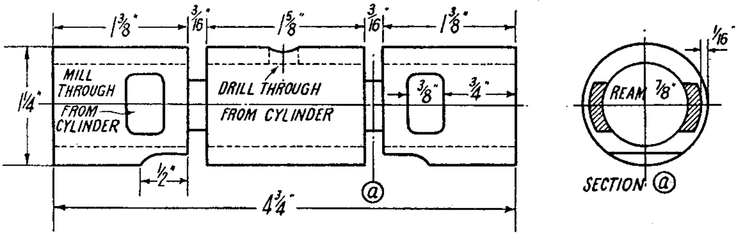
Screwy !

The odds are a million dollars to a pinch of snuff, that your bench vice won't open wide



Bolting face of cylinder, and back of right-hand cylinder

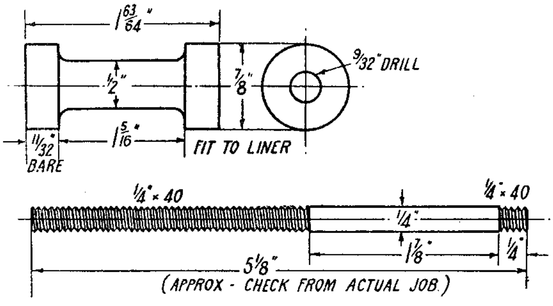
enough to allow it to be used for squeezing the liners into the holes in the cylinder castings; so if you haven't a bush or mandrel press, the best alternative is to take a wrinkle from the jobbing or garage mechanic, and do a spot of improvising. Incidentally, my own bush and mandrel press, which takes 12 in. between ram and table, cost £3 10s. 0d. before Adolf the Unworthy went nuts; I'm scared to think what the price would be now! It press-fitted the bits of *Grosvenor's* crankaxle so tightly that they are a fixture for good and all time, and squeezed the weeny cones into the injector with equal facility.



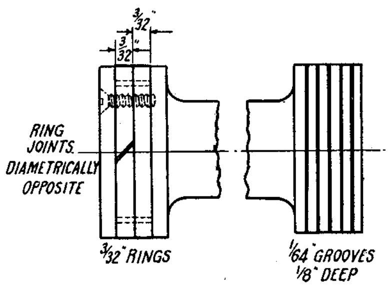
Details of steam-chest liner

First, push the slightly-reduced end of the liner into the steamchest bore, as far as it will go; a gentle crack or two with a lead or hide-faced hammer will prevent it shifting, but see that it is dead square with the faced end of the cylinder casting. Now get a bush, not less than $1\frac{3}{8}$ in. bore, nor shorter than $\frac{5}{8}$ in. long. Next, you need a $\frac{1}{2}$-in. bolt, nut to suit, and two stout washers, which should be perfectly smooth on both sides. The bolt must be threaded over half-way down. Put the bush and a washer on it, next to the head, poke the screwed part through cylinder and liner, then put on the other washer, and the nut. The whole issue will then look like the set-up shown in the diagram. Grip the head of the bolt in the bench vice, keeping the cylinder and liner vertical, then turn the nut with a long spanner. The liner will then be squeezed into the hole in the cylinder casting, the bush at the bottom end allowing it to stand out the correct amount from the other end. The liner, of course, should be set so that the flats on the bottom register with the passages in the cylinder.

If anybody should slip up and make the whole liner a push-fit in the hole in the cylinder, there is an easy way out. Well tin the outside of the liner with ordinary solder, all except about $\frac{1}{2}$ in. from each end. Put a coating of Baker's soldering fluid, chloride of zinc, or any other liquid flux, *not* paste, all over the inside of the steamchest bore; then push in the liner, taking the same strict caution as before, to see that the flats line up with the passage-ways, and the proper amount projects at each end. Then heat up the whole lot until the solder melts. Let it cool slowly, wash well in running water, scrape away all traces of solder showing on the projecting parts of liner, also from the cylinder flanges, and clean off any discoloration. The result will be just as permanent as a correct press-fit, and the working and efficiency of the engine won't be affected in the slightest. Whether the liner is pressed, or fixed as above, the steam inlet is then drilled, and the exhaust slots milled through from the cavity, exactly as described for the $3\frac{1}{2}$-in. gauge engine. Finally, put the $\frac{7}{8}$-in. reamer through the liners again by hand, to remove any burring, and correct any distortion.



Piston valve and spindle



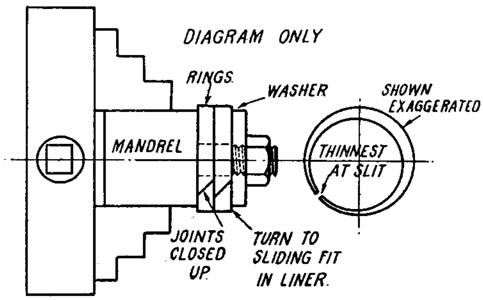
Alternative bobbins

Piston and Covers

Piston turning and fitting have been described in these notes so often, that our regular readers should be able to do the job with their eyes shut; and beginners have only to refer to the recent instructions for *Tich*, substituting the dimensions given in the accompanying illustrations, and they, too, shouldn't have the least trouble. Same remarks apply to turning and fitting the cylinder covers, and the piston-rod gland. The guide-bar boss is machined off, top and bottom, same as described for *Doris*, but the faces are $\frac{1}{2}$ in. wide and $1\frac{1}{2}$ in. between. When drilling the holes for cover screws, don't forget to space out the two

nearest the liner, to miss the passage-way ; and when fitting, a small segment is filed or milled out of each cover, to clear the end of the liner, as shown in the back view of the r.h. cylinder.

The steamchest covers are merely flanged plugs, the plug part being a tight push fit in the liner ; that at the front is $\frac{3}{8}$ in. long, and that at the back



How to turn piston rings

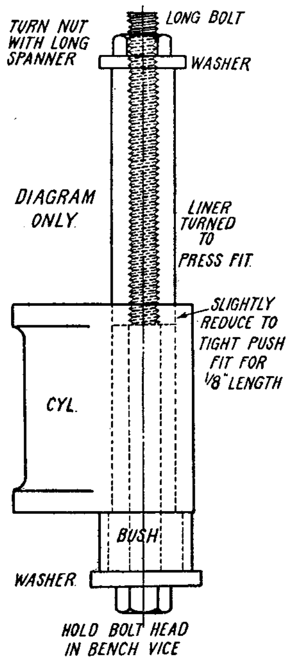
$\frac{5}{8}$ in. long. The extra length is to afford plenty of bearing surface for the valve-spindle. Valve-spindle crossheads and guides may, of course, be fitted if desired ; but they are not absolutely essential on locomotives below one-eighth full size. As most followers of these notes know full well, I design and build my locomotives on the same principles as a full-size C.M.E. who—unless absolutely crazy—wouldn't lumber up his engines with a lot of unnecessary fallals, especially in these days of " cut-expenses-to-the-last-farthing." Four 6-B.A. countersunk screws put through the end of each liner, into the spigots of the covers, will prevent them coming adrift, as shown in the sectional illustration.

Piston Valves and Spindles

If the $\frac{7}{8}$-in. reamer used for reaming out the steamchest liners cuts accurately, and has been used properly, a piece of $\frac{7}{8}$-in. ground rustless steel will be a perfect sliding fit in the liner ; and the bobbins will require no turning at all, thus entirely disposing of the bogey that is raised by all opponents of piston-valve cylinders. Merely chuck in three-jaw, face the end, and drill down a little over 2 in. with 9/32-in. drill. Turn away the bit between the bobbins, leaving a gap exactly $1\frac{5}{16}$ in. long—very important, that dimension !—leaving a $\frac{3}{8}$-in. bobbin at the end. Then part off to leave another $\frac{3}{8}$-in. bobbin at the other end. Re-chuck, and face off each one to a bare 11/32 in., so that the total length is 2 in. less, 1/64 in. The valve spindle is a $5\frac{1}{8}$-in. length of $\frac{1}{4}$-in. ground rustless steel, screwed as shown, the valve being held by two lock-nuts each end ; it should " float " on the spindle, without any end play.

If ground rustless steel isn't available for the piston-valves, or if it doesn't fit, the valves can be turned from ordinary drawn rustless steel, or hard phosphor-bronze. The fit should be the same as for a piston ; that is, a sliding fit without shake, when cold. The mechanical lubricator will maintain a film of oil between bobbins and liner, not only sealing them steam-tight, but minimising wear. However, some folk may prefer to add a refinement, so I have shown two alternatives ; what the old-time engineers called " labyrinth packing," and rings. The labyrinth packing isn't packing at all, begorra, says Pat, but consists of minute grooves in the bobbin, which become full of oil when the engine is running, and help to maintain the film between the rubbing surfaces. They can be formed by grinding up a bit of the last hack-saw blade you were unfortunate enough to break, to the shape of a parting tool ; this is fixed to the side, or in a slot in the end of a piece of square mild-steel bar, and used in the ordinary way, to form the grooves in the bobbins, same being held by one end in the three-jaw, whilst the tailstock centre is brought up, and entered in the hole in the outer end, as a steady.

Piston-rings are easy enough to make. Rustless steel is about the best material for rings on piston-valve bobbins, as bronze rings go as soft as putty under the influence of " red-hot " steam. I have tried them, and found it so. Incidentally, don't for one moment imagine I have suddenly gone



Simple way of pressing liner into cylinder

crackers on rustless steel ! There are places on a locomotive where it is entirely unnecessary, and other places where it is very advantageous, such as the case in point.

To make the rings, chuck a piece of 1-in. round rod in the three-jaw ; face the end, centre, drill down about $\frac{3}{8}$ in. or so with a $\frac{1}{4}$-in. drill, open out with $\frac{1}{2}$-in. drill, then bore to $\frac{3}{4}$ in. Turn down the outside for about $\frac{3}{8}$ in. length to about 1/32 in. over $\frac{7}{8}$ in. diameter ; then part off two rings each 3/32 in. wide. Slit these slantwise, as shown, with a very fine jeweller's hacksaw. Now make up a mandrel as shown in the detail sketch, from a bit

of $\frac{7}{8}$-in. round mild-steel. The spigot should be about $\frac{3}{8}$ in. diameter, screwed with a fine thread, and have a nut and thick washer to suit. Clamp the embryo rings between the washer and the shoulder of the mandrel ; but note specially—squeeze the rings so that the joints are closed up, and set the rings running slightly eccentric, the slits being farthest away from the centre of the mandrel. Now turn them until they are an easy sliding fit in the liner, and that is all there is to it. When released, they will spring out just the weeniest bit, enough to make them steamtight in the liner without causing friction. The groove in the bobbins should be just wide enough to admit the rings side-by-side, and about 3/32 in. deep. They may be sprung on, like automobile engine piston-rings, but in order to avoid risk of distortion, the bobbins could be shortened by 3/32 in., and turned with a step on each, 3/32 in. deep and $\frac{3}{16}$ in. wide. A plate $\frac{7}{8}$ in. diameter and 3/32 in. thick (slice parted off the rod used to make the bobbins) could be attached to the end of the bobbin by three or four $\frac{1}{8}$-in. countersunk screws, thus making up the length of the bobbin, and allowing the rings to be put on without any springing. The assembly of the complete cylinders is shown in the illustration and needs no further explanation.

Thank You, All !

The number of greetings, both cards and letters, which cascaded through the letterbox in the front door of our *hacienda* during the few days before Christmas, and a couple of days after, exceeded all records ; and I would like to take this opportunity of thanking everybody for their kind wishes, most heartily reciprocated. I have enough foreign stamps to start a collection ! Every single one was eagerly read and appreciated, and it brought a lump into old Curly's throat, to know that there were so many unseen friends all over the world.

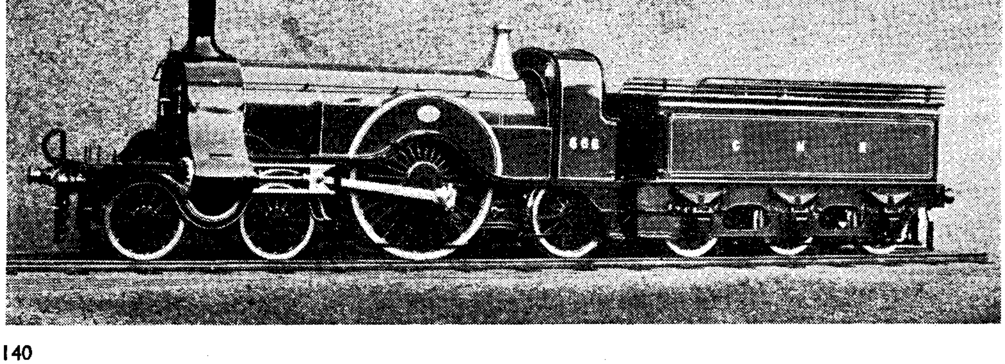
Although, at time of writing, it is only just over a week since my humble effort at entertaining readers with a railway ghost story appeared, I have already had some letters from readers who live along the route of the " Golden Arrow," or who travel on that section of the old Southern, saying that the tale read so " real " that they find themselves unconsciously listening for the " whoo " of *Lady Vera's* deep-toned chime whistle ; and they say that they wouldn't be in the least bit surprised to see the green-and-silver vision herself, with her chocolate-cream retinue, go flying past, with just a silvery blur playing around her wheel centres. Several others have said, why not have let *Lady Vera* take her train right through to the Gare du Nord, making the run non-stop to Paris, via the Channel Tunnel, in 2¾ hours. She would have been through the tunnel in about nine minutes ; and with a high-roofed bore, well ventilated with pressure fans (like the long tunnels in America), there would have been no inconvenience from steam and smoke, especially with air-conditioned cars. Well, there isn't any Channel Tunnel yet, and I have an idea there never will be, in this world of everlasting jealousy, mistrust and suspicion. *Lady Vera* might perhaps have made some of the S.N.C.F. compounds feel a bit jealous ; and, besides, she didn't know how to " whoo " in French !

A ¾-in. Scale " 8-Footer "

WE are pleased to be able to publish a photograph of a recently-built ¾-in. scale G.N.R. Stirling 8-ft. singlewheeler which is certainly a splendid " portrait " of its ever-popular prototype.

This fine model was built to special order by Mr. H. Clarkson, of Selby, Yorks, whose exact work is well known to many of our readers. We know that the prototype drawings were the basis of this engine, and the photograph shows that all visible details have been most faithfully reduced to scale.

We understand that on the day after delivery to its owner, this engine was steamed and ran a total distance of nearly 18 miles without trouble of any kind.



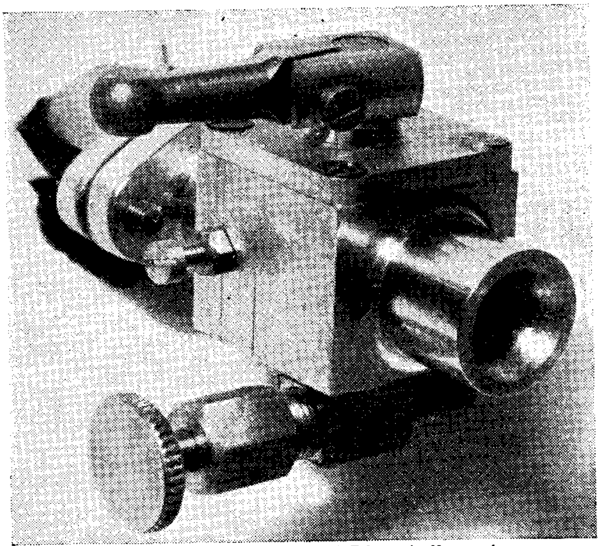
PETROL ENGINE TOPICS

*A General-Purpose 15-c.c. Two-Stroke

An Elementary Exercise in Model Petrol Engine Construction

by Edgar T. Westbury

IN nearly all small two-strokes produced either individually or commercially nowadays, carburation problems have been persistently side-tracked rather than any attempt being made to solve them. The most primitive devices are generally regarded as the only ones suitable for these engines, and one of the most important functions of the carburettor, that of controlling the quantity of mixture fed to the engine, and thus acting as a speed control, is entirely ignored. Such a policy would be quite untenable on any full-sized engine, irrespective of the purpose for which it is intended to be used, and it is only practicable in model engines because nobody worries about anything except their flat-out performance.



The carburettor of the "Phoenix" engine

One reason for the universal acceptance of the primitive type of carburettor is because, in the past, attempts to introduce elaboration into its design have often been unsuccessful. There are certainly many difficulties in adapting the exact design of full-size carburettors in a very small size; and even if this is done successfully, the adjustment of such carburettors to give a correct mixture throughout their full range of speed is by no means easy. No carburettor, however well designed, can give good results unless it is properly adjusted. But some of the "advanced" designs in small carburettors which I have seen have neither been well designed nor properly adjusted, and in these circumstances, it is easy to see why many engine constructors have obtained the most successful results with carburettors of the simplest possible design.

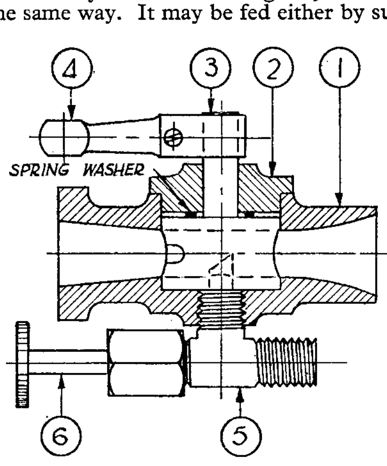
*Continued from page 91, "M.E.," January 19, 1950.

On the strength of a considerable amount of experimental work with small carburettors of various types, I can state quite definitely that it is by no means impossible to produce automatically-compensated carburettors in quite small sizes, though admittedly their construction, and even more so their adjustment, becomes more critical as their size is reduced. It is, however, possible to obtain reasonably good results over a wide range of speed control with a form of carburettor which embodies all the virtues of the ultra-simple type, avoiding the "mysteries" of submerged jets, air bleeds, and dashpots, the only complication being the addition of a throttle control. A carburettor of this type is not automatically compensated in the true sense of the term, but gives quite good results in practice.

Such a carburettor is shown in the drawing, where it will be seen that the main body or "mixing chamber" 1 is fitted with a barrel throttle 3, retained in place by a cover plate 3, and having an extended shaft or "pintle" to which is attached the control lever 4. The jet unit consists of a valve body 5 in the form of a tee-piece, the horizontal part of which is fitted with a screwed control needle, and the vertical part, screwed into the underside of the carburettor body, terminates in a discharge orifice or "diffuser," shaped at the mouth so as to produce the maximum suction effect to promote atomisation of fuel. For the purposes of illustration, the valve body is shown axially in line with the main body but it may in fact be turned to any convenient position, and, as the photograph shows, is actually at right-angles to the main body in this particular case.

When the throttle is wide open, as seen in the

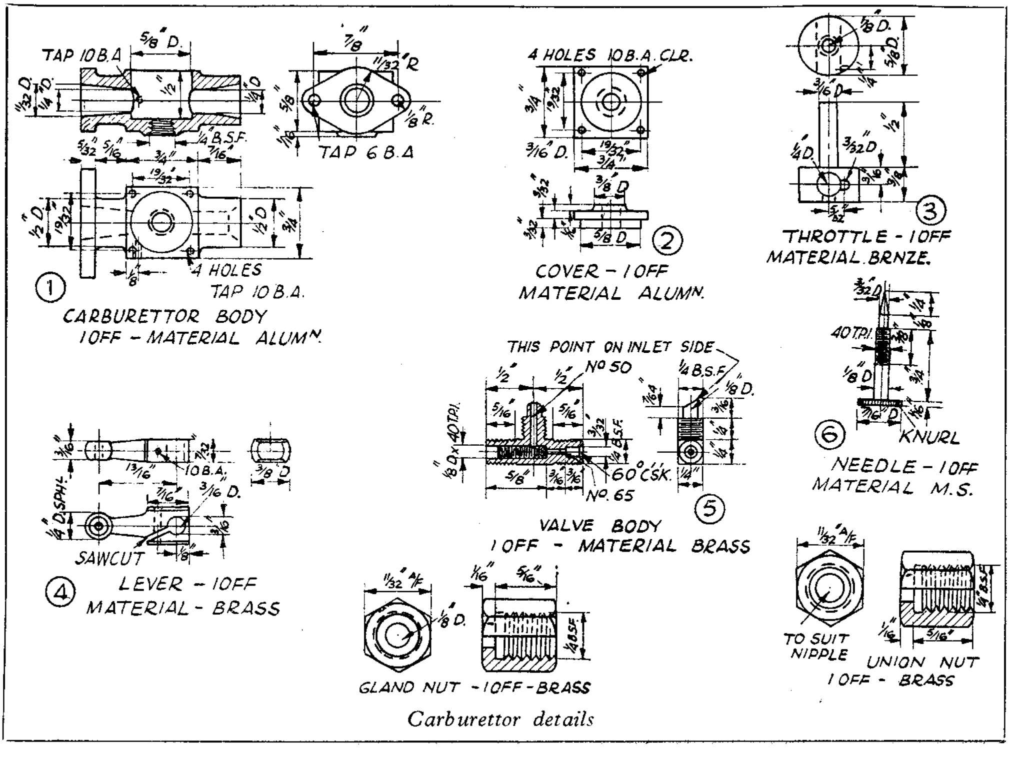
drawing, the carburettor is virtually identical in function to the plain tube " straight-through " type as usually fitted to small engines, and behaves in the same way. It may be fed either by suction



General arrangement of carburettor

or gravity feed ; if the fuel tank is deep and of large capacity, a float feed may be desirable and is easily added. When the throttle barrel is turned to restrict the passage through the main body, it reduces the area of opening at both edges, that is on both the intake and discharge sides of the jet, so that the air velocity and depression acting on the diffuser are kept fairly constant for any throttle opening. This avoids the violent changes in jet output which would be produced by placing the complete throttle valve either in front or behind the jet, and helps to keep the mixture at constant strength throughout the range. It does not follow, however, that perfect adjustment of mixture at all speeds can be obtained without some experiment in the size of passages and cut-off areas at the edges of the opening in the barrel. In motor-cycle carburettors with plunger throttles, it is usual to obtain local mixture control by varying the cutaway on one edge of the plunger, and precisely the same methods can be adopted in this case, allowing for the different order of motion.

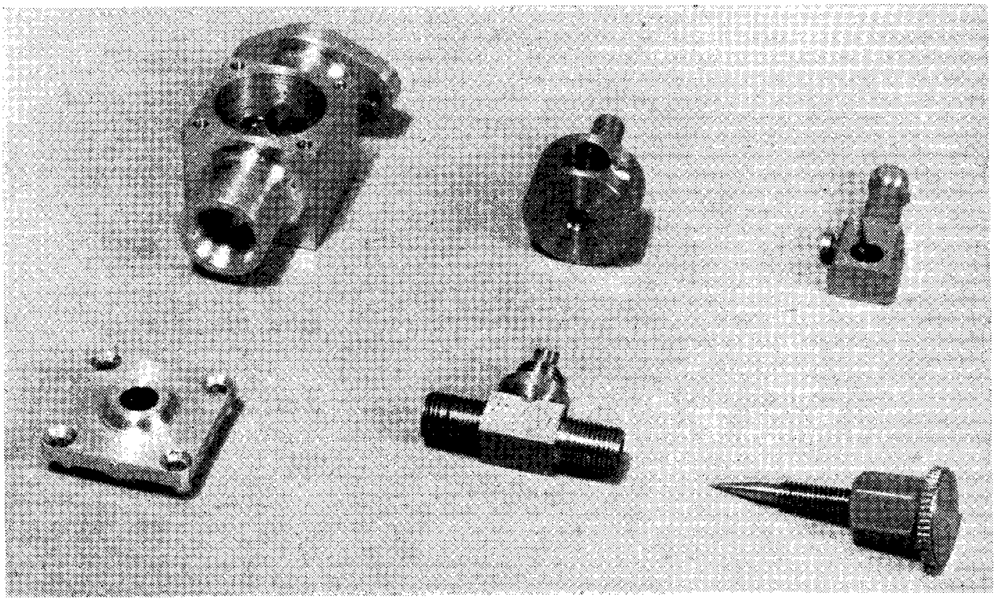
In the running adjustment of the carburettor, the jet needle should first be set to suit full throttle requirements, with the engine under load. The throttle opening should then be reduced cautiously, taking note whether the mixture gets weaker or richer as it is closed down. If in doubt, note whether the jet needle opening must be increased or reduced to obtain the best results at the smaller throttle opening. The latter is the more likely, and to compensate for it, a vee notch should be filed on the closing edge at the *intake* side of the barrel, so that more air is admitted at reduced opening. For the reverse effect, the obvious course is to file a notch in the closing edge on the *discharge* side of the barrel ; the procedure is quite simple and logical, and though the inexperienced engine tuner may scrap more than one throttle barrel before the desired results are achieved, it is a simple job to make a new one and should not cause alarm or despondency.



Carburettor details

The carburettor is provided with a slow-running or " idling " stop in the form of a screw which enters at a tangent to the barrel, and incidentally acts also as a full-bore stop, a notch being filed in the discharge side of the barrel to enable it to open fully before abutting against the screw. This does not in any way interfere with the adjustment of compensation by notching the other side of the hole ; but the presence of the screw itself projecting into the barrel makes some difference to the mixture control, and it should of course always be in place while tuning. When the idling position is set, the screw is locked by means of a lock-nut or other convenient means, and care should be taken to avoid the possibility of air leakage past the thread, or at the induction pipe joints.

Fuel feed should be so arranged as to produce the minimum variations of " head " or fuel level at the jet, as these affect compensation to a great extent. The best results are obtained when the fuel level is slightly below the lip of the diffuser. If a float chamber is used, it should be arranged to maintain this level ; the type of float chamber as fitted to the " Atom " Type R carburettor is suitable, but will call for modification of the jet and control needle design. Some constructors may prefer to eliminate " knob-twiddling " by using a fixed jet, which is quite practicable if one is prepared to take the trouble to find the correct size by experiment—the only sure way, even with the most scientifically-designed carburettors. It should be disposed vertically, below the diffuser, and should have a sediment well below it, as in the Atom Type R. But the control needle has its advantages for small engines, where the mixture may vary through slight differences in the amount of oil in the fuel, or by gummy residue in fuel passages, and I find that slight readjustment of the jet opening now and again is very desirable—indeed, sometimes almost indispensible.



Carburettor components

Carburettor Construction

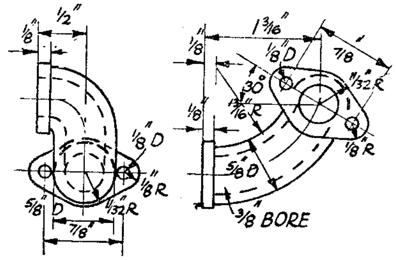
Most of the components are extremely simple to machine, and call for little explanation. The carburettor body, as shown in the photograph, was machined from solid aluminium alloy, and some constructors may prefer to make it in this way, although a casting either in light alloy or gunmetal will be available. It may be held by the flange end for facing, boring and flaring out the intake with a hand scraper or form tool (the exact shape is not of the highest importance) and at the same setting a skim may be taken over the outside of the intake to enable it to be held reversed in the chuck, for facing the flange and forming the taper in the bore (which should not extend beyond the aperture of the barrel seating) by means of a boring-tool or a taper reamer.

For boring the barrel seating the body may be held crosswise in the four-jaw chuck, with finished surfaces protected by soft metal or fibre packing, but there is less risk of bruising them if it is mounted flange downwards on an angle-plate by means of a strap and two bolts. This also ensures that the throttle axis is dead square with that of the main passage. The seating is bored to a nice smooth finish, also the outer flange faced truly and the hole drilled and tapped to take the valve body, at the same setting.

The throttle barrel should preferably be made of tough bronze—brass is liable to be " sticky " in action—and is turned to a nice easy, but not sloppy, fit in the body. It may be cross-drilled slightly undersize, but the final opening out and finishing of the hole is best carried out *in situ.*

All burrs should be carefully removed from the edges of the hole. Next, turn up the throttle cover, drill and tap the holes and secure it in place with the barrel also inserted, and clamped in the full-bore position by placing a washer or similar packing on the pintle. The body is now re-chucked and the hole bored to size with a small boring-tool, finishing with a D-bit or reamer.

The throttle lever may be made from $\frac{3}{8}$ in. × $\frac{1}{4}$ in. brass rod, though $\frac{3}{8}$-in. round material is permissible if it is filed or milled flat on the top and bottom afterwards. Turn the taper shank and ball end, and before parting off, drill the cross holes, finishing the $\frac{3}{16}$-in. hole. to a tight fit on the barrel pintle. While the lever is still attached to the stock, it may be held in the lathe toolpost and the oblique slot cut with a small circular saw ; then cut it off, tap the hole for the clamping screw, and clamp the lever to a piece of $\frac{3}{16}$-in. rod for facing the top and bottom surfaces on both the ball end and the clamp.



Induction pipe

If the lever is to be connected up to a remote control, the barrel may be shimmed up to work freely, but without end play ; but otherwise, it will be advisable to fit some form of friction device under the cover, such as a phosphor bronze or spring steel washer about 0.015 in. thick, bent across the middle so as to press against both contact faces, as indicated in the general arrangement drawing.

A standard form of tee-piece may be used for the valve body, and the most important essential in machining is to ensure that the tapped hole for the needle, the jet orifice and the external thread for the gland nut are all in true concentric alignment. At the other end, the thread for the union nut must also be concentric with the conical seating. A properly aligned tailstock die holder should enable true threads to be produced without difficulty. Either 40 or 32 t.p.i. can be used for both gland and union threads, according to what is readily available ; and the vertical part of the body may be similarly threaded if desired.

Note that the highest point at the tip of the diffuser must always be towards the intake when the valve body is assembled, so if the position of the fuel inlet is varied, this should be given due attention. If desired, the diffuser may be made from a piece of $\frac{1}{8}$-in. tube, inserted fairly tightly in an enlarged hole in the tee-piece, and this will enable it to be turned into the correct position, irrespective of the angle of the fuel inlet. Its height should be adjusted so that the tip is as near as possible on the centre line of the main passage.

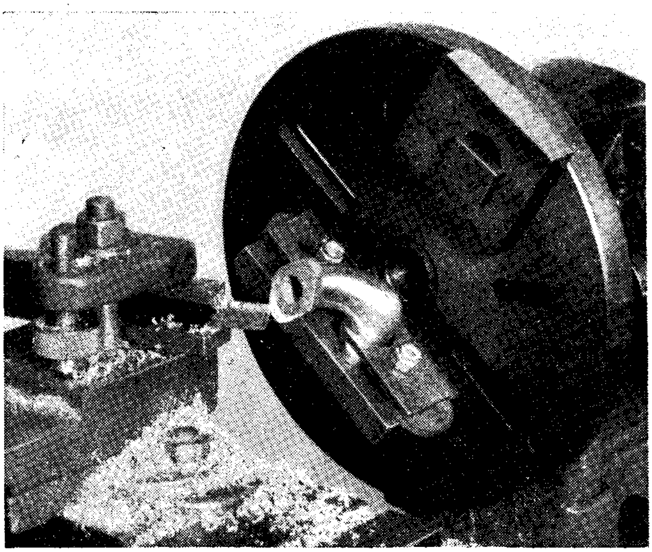
The screwed needle is best made from the solid, which is not difficult if the plain end and the taper are finished first, before turning down the threaded shank. Note that the plain portion under the head screws right into the clearance in the tapped hole when in the working position ; this avoids jamming the gland packing in the threads and ensures maximum length of wear without leakage. A small cork bush, formed by pressing a plug of cork into the gland bush, and drilling it in the lathe while in position, has been found best for keeping the gland petrol-tight. For two-strokes with petroil lubrication, a mild steel needle is satisfactory, but bronze, nickel-silver or stainless-steel are better, as they eliminate all possible risk of corrosion or fouling. Avoid the formation of ridges on the needle at all costs. The head of the needle is knurled and may with advantage be indexed to show the setting, when it is once determined.

Induction Pipe

This may be regarded as an optional fitting, though some form of induction pipe is desirable, and in the case of two-stroke engines with the normal piston controlled admission port, the length of the induction pipe has an important bearing on efficiency. Various induction systems and carburettors have been tried out in the course of developing this engine design, and all work reasonably well, but the arrangement shown has given the best all-round results, including easy starting, flexibility and peak performance. A cored casting is provided for the induction pipe, and it may be mentioned that the crooked core has caused much weeping and gnashing of National Health dentures at the foundry. Constructors with a flair for "copper-bashing" may prefer to try fabricating this component, which will certainly make a neater job if properly done ; but it will be seen that one of the bends is a very short one, and may be found difficult. It is not, however, necessary to observe the exact shape shown, and an easier bend would be desirable, provided that the pipe does not foul other fittings when the engine is assembled. In the photograph of the early engine on page 719 of the December 8th issue, it will be seen that the inlet pipe is attached at the flywheel side of the engine—or perhaps it would be more correct to say that the flywheel is fitted to the carburettor side—and this made it desirable to use an induction pipe machined from the solid, and having a more abrupt bend than was really comfortable, though it worked well enough in practice.

The machining of the two joint flanges on the pipe was carried out by mounting it on an angle-plate, as shown in the photograph, and this illustration explains itself. It will be seen that a special clamping plate was made to give as effective a bearing as possible on the back of the flange ; this served for both ends of the pipe. The unmachined face of the flange first used as a bolting face was trued up with a file sufficiently to bed down flat on the angle-plate, so as to ensure that it was clamped securely for the first operation ; for the second operation, however, a

slip of brown paper was interposed between the machined flange and the angle-plate to protect the finished surface. Exact centring of the flange-faces is unnecessary, as only a face cut has to be taken, and no machining of the bores is desirable, or indeed possible, though they may be riffled or cleaned up with a rotary tool as far as accessible.



Facing the induction pipe flanges

Drain Valve

The fitting of a drain valve to the crankcase is, of course, optional, and it has not been thought necessary to show this in detail, as any small stop-valve or bib cock may be used, and the extension handle, to facilitate manipulation of the valve when the engine is installed in a boat or other position which makes access difficult, is also a matter of personal choice. But I have often found a drain-valve very useful, especially in boats which encounter heavy weather, or temporarily indulge in submarine exploration. Many of the small petrol or c.i. engines which get into inexperienced hands would be much improved by fitting such a drain ; when the engines refuse to start, by reason of faulty ignition or other causes, it is not uncommon to find the crankcase about half-full of fuel, and the prospects of getting them to start then, unless and until thoroughly drained out, are very remote indeed. A drain plug is quite all right, but if removed in the field or at the pond, is only too frequently lost.

This concludes the description of an engine which will, I hope, interest many readers who have not tackled this class of construction before. The chances of building such an engine successfully at first attempt are, I think, greater than with a smaller engine, even if the latter should appear superficially much simpler. Though I am always against regarding engines simply and solely as a means to an end, constructors who wish to apply this one to a real job of work will not be disappointed, while many, I feel sure, will find that an engine which can be controlled is a welcome change from the common all-or-nothing variety. There are many variations of the basic design possible, and from past experience I have no doubt that readers will not fail to explore them extensively. If desired, the cylinder and head may be modified to enable the engine to be water-cooled, though I am personally of the opinion that the fitting of a fan and cooling duct would be much less troublesome and effective.

Castings for the " Phoenix " engine can be obtained from Craftsmanship Models Limited, Norfolk Road Works, Ipswich.

A Battery-Driven Electric Clock

(*Continued from page* 135)

end of the trigger resting in the vee-groove on top of trigger block, the contacts closed just as the edge of the armature reached the edge of the pole pieces on its rightward swing.

A three-volt cycle lamp battery was now connected up, one pole of the battery going straight to one wire on electro-magnet, and the other pole of battery to the wire connected to pillar (*C*) and the wire from pillar (*B*) to the other wire on electro-magnet. These connections were all of a temporary nature, the battery being hung by a piece of string to a nail driven into the baseboard.

The pendulum was then given a starting swing, and much to the writer's surprise it carried on, and ran for over two minutes between each contact. It was left to run for several days like this, several adjustments being made from time to time to trigger block and contacts, to try to improve matters. Attention was then given to the wheelwork, which will be described next.

(*To be continued*)

*TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally but very different internally

THERE are times when I wish we could have a " Stop Press " column somewhere in THE MODEL ENGINEER.

Things that are interesting at the time of writing, have a way of becoming merely historical memories, and it takes some time for hard-working editors to settle questions of make-up and space availability. After this, the printers require to have material in hand for some way ahead, with the result we all know.

I have had a long illness running to nine weeks, and with five of them flat on my back, and it was most fortunate that I had " Twin Sisters " material written up some way ahead, but not so the drawings, or at least, not all I wanted; but now, fortunately the gap is filled.

They say that the perfect opportunist has no idle time; not that I claim to fall into this category, but my five " black weeks " were not all spent in sleeping and eating grapes. I was able to assume a propped up position ; in fact, I more or less had to, and paper and pencil were not far away.

Amongst other things, I got down to the question of working out accurately the vexed question of energy transmitted to the driving wheels of a locomotive, as compared with the energy produced in the cylinder—an entirely different matter.

By setting off with quite definite, but hypothetical sizes of cylinders and steam pressures, I arrived at some equally definite, but hypothetical results, all relative to what actually happens at the point where the wheel rests on the rail head, which is the only thing that counts in the long run.

Some people can see and digest figures. I can digest them, but I cannot see them as clearly as I would like to. The result was that I felt compelled to draw the pictures as well, so that figure pictures, or graphs were prepared. These were unorthodox in that I made the figures occupy spaces or areas proportional to their true values. By doing this, the veracity of the graphs was not impaired, but visually and pictorially improved, and to such an extent that other relative factors immediately and obviously became apparent.

The first and most important contributing factor was that of wheel slip—obvious causes thereof. I say obvious because when you actually see the steam punch or poundage as delivered to the rail head, and the way these spasms of effort overlap each other in the course of a single revolution of the driving wheel, you can immediately see—abundantly clearly—the " for's " and " against's " related to multi-cylinders, oversize, undersize, high pressure, low pressure, early admission, negative lead and so on.

Perhaps the most telling part of the whole picture, is the partial deflation of the theory that steam admitted very early to the cylinders does so much good work—just like the early worm in armour shining bright (something gone wrong here, I never did trust that 4d. edition of Shakesworth).

The trouble lies with the bloke who invented the crank (he *did* you know, *and* patented it—or tried to) with the result that we have inherited a mechanism strongly tied up with our friend the piston and cylinder, and in such a way that the piston, unlike the early worm (let's leave out the bit about the armour, shall we ?) never really does a good job of work until about mid-day, or half stroke. Instead of regarding the exhaust steam as an invisible export, and really making up its mind to put its back into it well before lunch, it demands time and a half, in terms of steam pressure, *before* it has really started off on its journey, and at least time and a quarter for everything after 4 o'clock. *Really*, Mr. Steam Engine, I never fully appreciated just how you felt about it.

Now, with a really long cylinder and high—— Yes, Mr. Editor, you *are* paying for this article— Yes, I'll go back to work now !

The Eccentric Yoke

If you are satisfied that the above title is not the result of my illness, and that I shall not attempt to embark on a story of an egg that wanted to wear a collar and tie, we will get back to work.

The yoke is to be had in casting form, with the same alternative given with regard to fabrication. Fabricated, it would consist of a piece of bar and a piece of $\frac{1}{4}$ in. brass or bronze plate.

The bar might with advantage have a slot milled down its length to accommodate and firmly hold the plate during the brazing or silver-soldering operation ; or, better still, it could be drilled out a little undersize beforehand. In either case, the depth of such a slot should not exceed half the wall thickness of the tube or drilled-out bar section.

If you have bought the casting, start off by de-sanding completely, and thoroughly cleaning the two side faces of the yoke. These need not be machined, but they do make incipient contact with the flanges on the eccentric. It will be noted that the yoke finished thickness is less than the track on the eccentric, and this is to allow for the float on the driving axle which might otherwise cause binding.

*Continued from page 91, " *M.E.*," *January* 19, 1950.

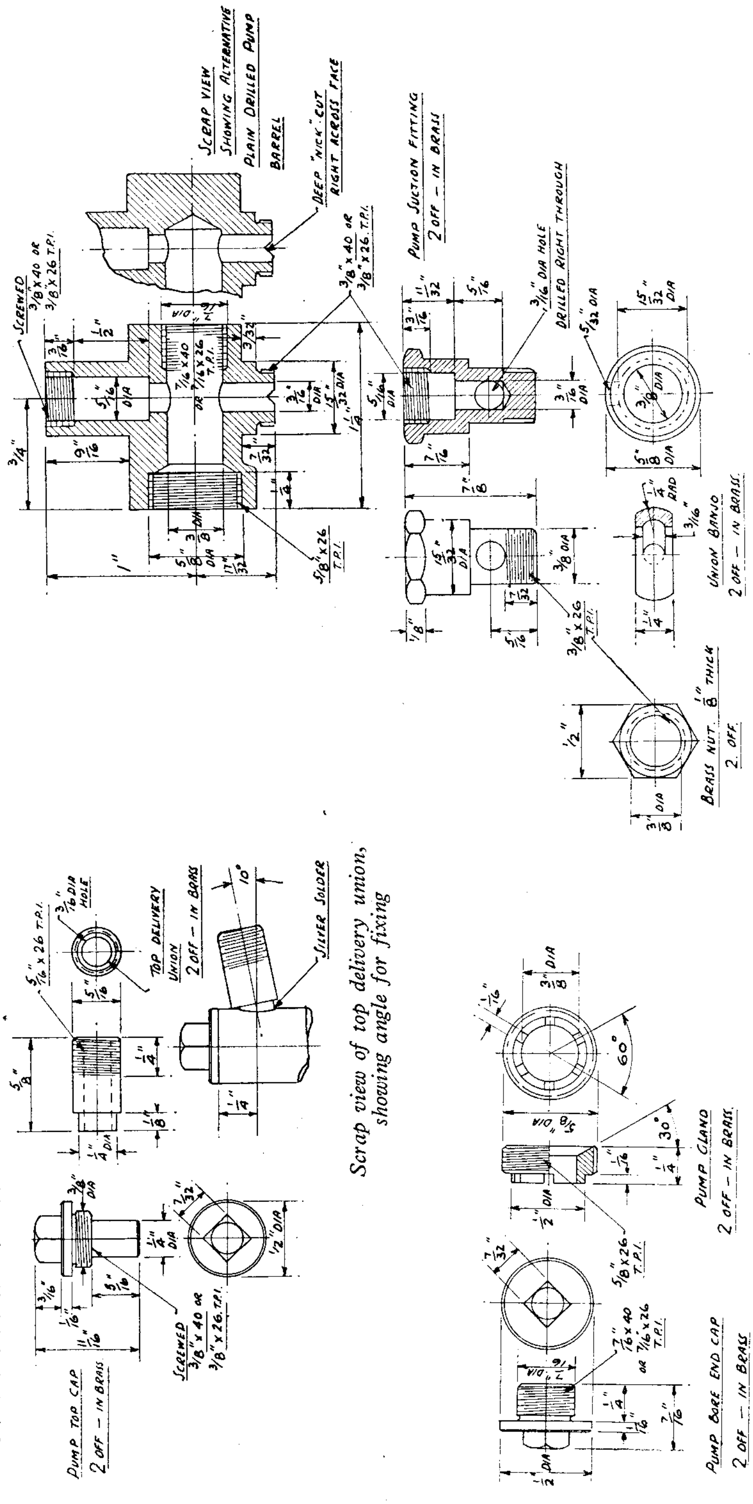
The best way to clean out the inside of the yoke is to mount it on the faceplate, and bore out the top arch. When this is done, the two straight sides should be filed down carefully until the yoke will just slide over the eccentric. Do this part of the work very carefully, as a badly fitting part will be much more troublesome than a badly fitting eccentric type of drive, and will probably run with an irritating clicking sound when working under load.

Once this has been done you can set about drilling or boring out the top sleeve to its final size, and again the small angle-plate on the face-plate can be brought into use. A very simple type of clamping through the centre of the part, and packing or large flat washers underneath will hold it clear of the top sleeve side bulge.

This method also enables you to get the bore of the sleeve quite square with the throat, and to bore, rather than drill, the long hole. I mention this because it is often found that the standard drill, or even reamer, fails to produce the exact size required, and it is important that the pump plunger should not be loose in it.

This would introduce wracking that would in a very short time, weaken the fixing pins that go right through both yoke and plunger.

The bar tie or keep that goes at the bottom of the yoke is also very essential, and will prevent any tendency for the throat to spread at its lowest and weakest point. This has been arranged so that, in the event of your wanting to remove the axle, the keep-nuts can be slackened and the bar lifted out, without having to take the nuts right off. How much more con-



Scrap view of top delivery union, showing angle for fixing

venient is this method compared with the job of fiddling about with eccentric strap bolts, or the usually inaccessible wrist-pin in the plunger. Not only that, except for the surface friction of the eccentric in line contact with the sides of the yoke, there is no upward or downward reactionary thrusts on the axle itself which, on some engines with badly placed pumps, gives the impression of an elderly gentleman with rheumatism in one of the main joints.

The next thing to do is to position the yoke on the pump plunger. First of all, drill the two sets of holes through the yoke top sleeve, tapping just one of these with a convenient size of thread, and providing a temporary set-screw—brass for preference.

Now assemble the whole unit with plunger and yoke in position. By having the set-screw medium-tight, you should be able to turn the wheels and eccentric, adjusting the position of the plunger until it does not foul at either end of its stroke. As a further precaution, you might insert into each pump part before assembly, a thin washer to maintain the desired clearance from dead bottoming at each end of the stroke. Remember to shake these out when you again dismantle for drilling the final holes for plunger attachment.

Before doing this, and having found the desired setting, tighten the set-bolt right up, and drill the vacant set of holes for pinning with a 3/32 in. stainless- or silver-steel pin. Once this has been done, and the first pin is in place, the set-bolt may be removed and the other through-drilling carried out.

Some men like to use taper pins in conjunction with the correct reamer to suit, and very good they are, too. In critical places, I like to add to security by riveting over the projecting small-end very slightly, but this is just a matter of taste.

With the exception of seating the ¼ in. diameter balls (and I think you all know about that now) the pump job is complete, but I would like to recommend the use of bronze balls rather than stainless-steel. During the last few months I have had quite a deal of trouble with the latter, and have had to replace them with the former.

In every case, the steel balls have become pitted quite deeply, but no damage has been done to the seatings—mainly in bronze or gun-metal. It is interesting to note that most of the affected fittings were working under hot conditions, and the results may have their origin in some electrolytic reaction. When one considers that some four tons of water have been through the boiler in question, and that free carbonic acid is found in most town water and in rainwater as well, the deduction made is quite feasible. All the fittings that from the beginning had bronze balls, have given no trouble at all.

You will also require packing in the two glands of the pump, and graphited yarn does very well for this. Some time ago, Mr. E. T. Westbury in one of his articles, gave a sketch of a simple rig for making up pre-pressed packings in a variety of materials, and I have nothing but praise for the idea. Apart from the general neatness of the prepared ring, it cuts out a lot of bother with the frequent readjustments otherwise so frequently called for during the period in which a gland settles itself down; and with a new engine, one may have to do the rounds of gland tightening after almost every run.

Finally, for the benefit of the paint-as-you-go men, the pump bodies should be in red, with all glands, caps and unions left bright. The yoke should be in dull black with its keep left bright. The keep *ought* to be in stainless-steel, due to the general proximity of water, but if any other material has been used, of a rustable variety, then paint it as well.

A friend asked me for my views generally on compound working the other day, particularly with considerations of the limits of British gauge restrictions, and all with a view to the small locomotive rather than the full-size job. I said that I required notice of that question.

Since then I have given much thought to the problem, and it would appear that, tackled in the right way, there should be no serious obstacle in the way of getting out a good design.

The biggest obstacle is with the sheer size of the low pressure cylinders, which nearly always precludes their positioning outside the frames, whereas the high pressure cylinders will go inside the frames without any bother. I think I would tackle part of the problem by dealing first with extra high steam pressure which, with its resulting high steam temperature would be half the battle.

One of the effects of using high steam pressure with small cylinders is to produce what I call "harsh working." There is a noticeable loss of smooth and even working, and a very severe falling off in performance with falling steam pressure, to an extent not nearly so noticeable with the medium pressure jobs.

It is reasonable to assume that, given the very high steam pressure boiler, coupled to the small cylinders, that medium size low-pressure cylinders should balance out the harsh working referred to, and give good, economical results.

The normal use of a "simpling-valve" for high starting torque would not, in such circumstances, exhaust the boiler so completely as if it had to supply a couple of "dustbin" cylinders.

What we really require is something not quite as drastic as the direct admission of high pressure steam to the low pressure cylinders, but rather an additional valve arrangement that would act as an infinitely variable proportioning valve, capable of being set to suit the hauling conditions prevailing.

Once this condition is obtained, there are a number of courses open to us in further application. One of these would be the fitting of three small high pressure cylinders inside the frames, with *a fixed and constant gear setting giving about* 80 *per cent. cut-off*, and with two outside low pressure cylinders incorporating the normal gear plus the proportioning admission. Not only would such an arrangement give the very best starting torque, but it would allow of an economical working not easily obtainable in the other more normal methods.

(*Continued on page* 153)

Disappointment to Satisfaction

The Story of the Port Talbot, Neath and District Society of Model Engineers, recorded by the Hon. Secretary, D. Elwyn Evans

THE Society first saw the light of day, during September, 1947.

This first meeting owed its existence to the energy and infectious enthusiasm of the then secretary, Mr. Watson, for he had "rounded up" over a dozen people for the event.

The first meetings took place in a spare room at the home of one of our members, and we met simply to talk about what we were each doing, and, I am afraid, sometimes to envy clubs which had been more fortunate than ourselves. For space is at a premium in this town, and the "powers-that-be" would not entertain the idea of a track in the park. At this period, "Ours" was filled with news of delighted clubs which had been granted permission to build tracks in parks by various Councils, and how we envied the Birmingham continuous track. However, we were not dismayed, and we went all out to convert everybody to our way of thinking. The only immediate result of this was a steady decline of members from the original fifteen to a meagre six. These six stalwarts continued to meet in Mr. Williams's workshop and discussed the problems on hand. The club had now formulated its rules, and all it now needed to make it complete, was a clubroom, track and some members.

We called ourselves the Port Talbot, Neath & District Club, since neither of the towns mentioned were really big enough to support a club on its own. And now the friendly rivalry between the members of the club began in earnest. Those in Port Talbot naturally wanted the headquarters in Port Talbot, while Neath members could not give one "logical" reason why anyone should want the H.Q. anywhere but in Neath. It was agreed that wherever the first suitable place was found and accepted, all members would abide by it.

On January 7th, 1949, the blow, as far as Port Talbot members were concerned, fell. We were invited to view some premises, complete with room for a track, and were told that the rent would be one shilling per annum. We accepted the offer with many thanks and as a small token of our appreciation, we asked the kind donor if his son would do us the honour of becoming our president. This offer he was kind enough to accept, and, at the same time, he assured us of his keen interest in the club.

On February 4th, 1949, the first meeting in our new premises was held, with twelve members present. Meantime, our members had not been idle, for, during the preceding months, no fewer than five 3½-in. gauge locomotives had been started. The first to be completed was a "Juliet" by G. Morgan, who is our youngest member. This was his own work, except for the braking of the boiler, which was a bit too much for a "one man" effort. But we feel, that it should be put on record that a nation-wide famine in 6- and 8-B.A. taps was only averted by the timely intervention of his uncle, S. Morse. What else *could* he be but an engineer, with a name like Morse?

However, despite the firm conviction of friend Morgan that everything on "Juliet," which he had not made himself would either blow up or bend, she successfully acquitted "L.B.S.C.," Morse and herself, by hauling with ease, everything we put behind her. Some of the less kind members say she is only trying to get away from the headlamp she carries on her front buffer beam, but, nevertheless, she is a fine locomotive, and one more living tribute to the unequalled genius of Curly.

She was christened *John Bevan*, in honour of our President, and she has done plenty of hard work hauling passengers at the Llanelly and Margam Exhibitions, and has generally behaved like the perfect lady. There are under construction at the moment, three "P.V. Bakers," a "Heilan' Lassie," a "Juliet" and a free-lance 4-8-2, all for 3½-in. gauge; a 2½-in. gauge "Purley Grange," a 25-c.c. i.c. engine, as well as several clocks, stationary engines, etc.

On October 6th, we held a one-day exhibition to which were invited our president, Major John Bevan, his father and mother, Col. and Mrs. J. M. Bevan, and at which our chairman, Mr. Tudgay, made a little speech thanking our president for his generosity to the club and welcoming him and his friends to our show.

Great interest and amazement were shown in the models by our visitors, and while they were being examined, steam was raised in *John Bevan* and Mr. Tudgay's 2½-in. gauge 4-6-2 L.N.E. Pacific. Our president and his father and mother much enjoyed riding the "iron-road" behind these two locos. The evening was most successful and, judging by the number of strangers who "found" their way into our meeting place, it resulted in considerable free publicity in the area.

We have only about 120 ft. of straight multi-gauge track at the moment, but our winter programme includes the extension of this to 200 ft., and the starting of work on a continuous track to be completed in two to three years. The length of this can be anything up to 1,000 ft. so that, out of our present membership of twenty-eight, those six members who began two years ago envying Birmingham S.M.L.E.'s track, may, in two or three years, find consolation in the thought that Birmingham probably envies them!

Novices' Corner

Using the Hacksaw

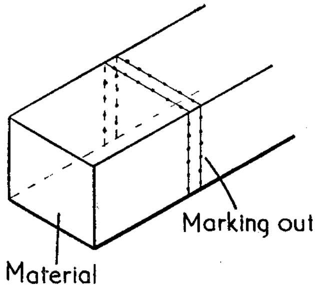


Fig. 1. Method of marking-out bars

ALTHOUGH manufacturers of hacksaw blades issue instructions for the correct use of their products as a guide to less experienced workers, this advice, which is always explicit, can hardly be expected to deal with all the minor problems involved, which from time to time arise in the small workshop. Again, instructions for selecting the correct type of blade to use for any particular purpose will be found in the makers' lists, together with the various forms of hacksaw frame suitable for all ordinary work. The temptation to use the blade that happens to be mounted in the frame, whether suitable or not for the work, should be resisted, as, apart from cutting indifferently, the blade may be damaged and money thus wasted on replacements. In this connection it is advisable to buy two, or more, saw frames ; one can then be kept for brass and the other for steel, or, alternatively, the frames can be fitted with blades having coarse and fine teeth. In addition, a small Eclipse saw frame to take blades 6 in. × ¼ in. should be purchased, as this size of frame will be found best for light work or for use in confined spaces. The hacksaw is used for two distinct duties, the first to cut off pieces of material which are required for machining purposes, the second to remove surplus metal from components under construction.

Even when using the saw for cutting material it is a good habit to mark out the bar to ensure that the cut is made square. This cannot, of course, very well apply to round bars, but the marking-out of rectangular sections presents no difficulty and should consist of parallel lines round three sides of the work ; these lines then serve as a guide for the saw. Fig. 1 shows diagrammatically the method of marking-out. If thought desirable, the centre punching shown may be omitted, nevertheless, it should be borne in mind that these punch marks allow the original lines to be re-drawn should they become obliterated.

The saw cut should be started on the side farthest from the operator ; this will prevent the teeth from being broken by coming into contact with the vertical face of the work.

When the hacksaw is used for the removal of surplus metal the work must again be marked-out to guide the path of the saw so that the part is cut nearly to the finished size, thus saving unnecessary filing at a later stage. Work which allows unwanted metal to be removed at a single pass offers no difficulty, but matters are not so easy, or so obvious, when it is impossible to do so.

As an example, cutting the gap in a grinding rest is carried out in the series of operations illustrated in Fig. 2. The first step is to mark-out the work as shown in Fig. 2 (*a*). Next, two vertical saw-cuts are made between the parallel guide lines as in Fig. 2 (*b*). These are followed by a cut along one of the diagonal lines, which removes the large triangular segment shown in Fig. 2 (*c*). A cut is then made along the remaining portion of the other diagonal which also removes a further substantial amount of metal as depicted in Fig. 2 (*d*). These cuts will have removed some threequarters of the unwanted material, but as the remaining metal cannot be sawn off with a blade of ½-in. width, a 6 in. × ¼ in. Eclipse blade mounted in a suitable frame is used instead, leaving the work as shown in Fig. 2 (*e*). Next, a square file is used to form a gap that will allow the ¼-in. blade to remove the final piece of surplus metal by sawing along the horizontal marking-out lines, Fig. 2 (*f*). To afford better control of the saw, the work is turned at right-angles in the vice, so that the blade cuts vertically. The final operation consists in filing the sawn edges square and exactly to the marking-out lines.

Sometimes slots or gaps similar to that just described have radial corners produced by

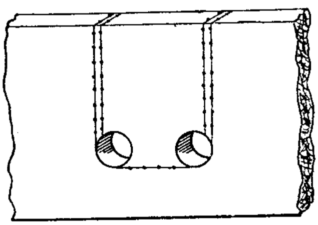


Fig. 3. Radial corners produced by drilling

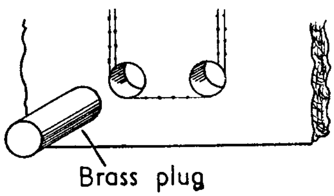


Fig. 4. Using a brass plug to prevent damage to corners

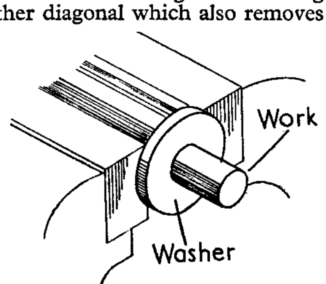


Fig. 5. Using a washer as a fence

drilling as shown in Fig. 3. Unless care is taken, the saw may easily damage the corners of the work as it breaks through into the drilled hole. To avoid this, firm-fitting plugs made of brass rod are inserted in the holes as shown in Fig. 4.

When round material has to be sawn off close to a shoulder it is a good plan to slip a washer over the work to act as a fence. The work is held in the vice and projects for the requisite distance ; at the same time an allowance must be made for the thickness of the washer, Fig. 5. It is sometimes necessary to cut out an internal profile, an example of which is shown in Fig. 6 (*a*). The first step is to mark-out the work. Next, as shown in Fig. 6 (*b*) a series of holes must be drilled at opposite corners. Before doing so, however, the centres of these holes must be marked out to avoid drilling into the lines of the profile and to obviate the holes themselves breaking into one another. A suitable drill size for this operation is $\frac{3}{16}$ in.

The holes are then opened out with a square file to allow a saw blade to be passed through the work, as seen in Fig. 6 (*c*). Sawcuts are then made to remove the unwanted metal. Finally, as shown in Fig. 6 (*d*), the work is filed along the scribed lines to complete the operation.

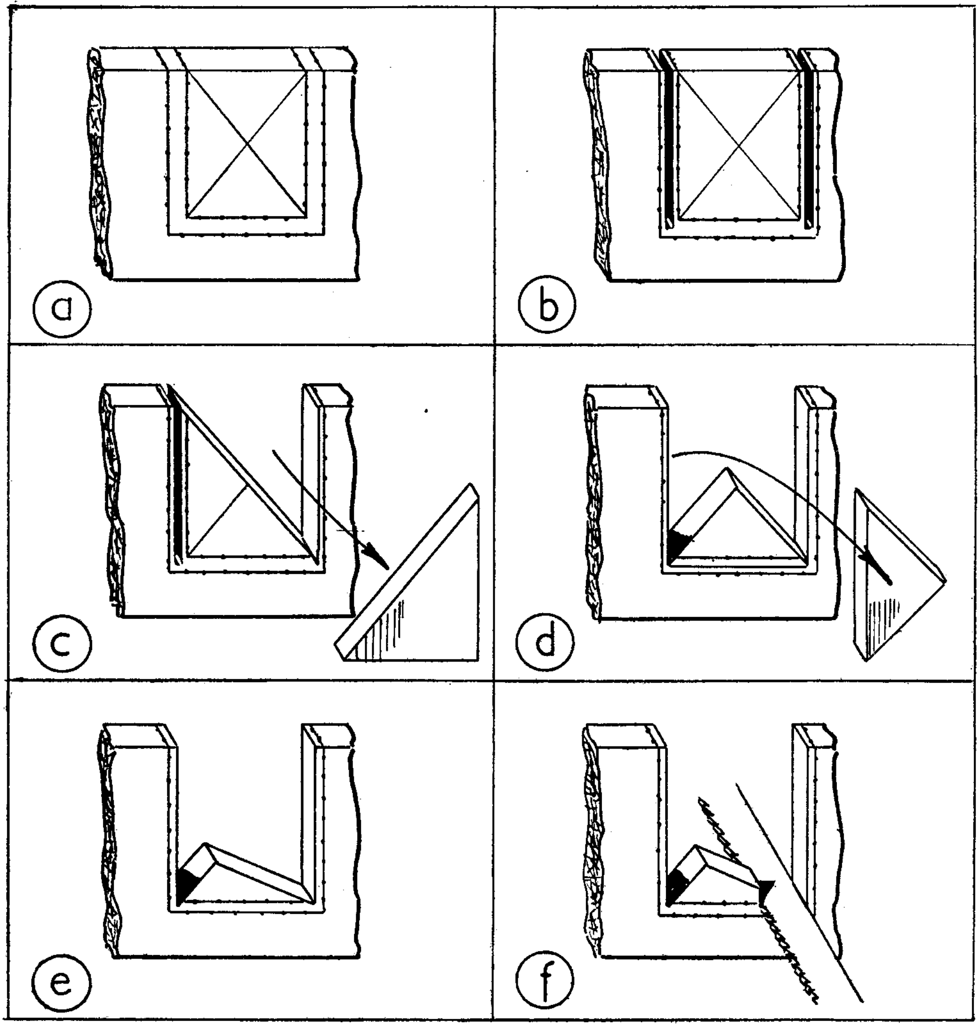


Fig. 2. Cutting a gap in a piece of material

Internal profiles which have radial ends are somewhat less difficult to cut as the radii can first be produced either by a drill or, in the case of large radii, by boring in the lathe. An example of this is shown in Fig. 7 (*A*). As will be seen in Fig. 7 (*B*), after marking-off two holes, whose diameter equals the width of the profile, have been made at each end. One of the holes is then opened out with a file, as shown in Fig. 7 (*C*), to allow the saw blade to be entered, but before cuts are made, a plug should be fitted to the other hole

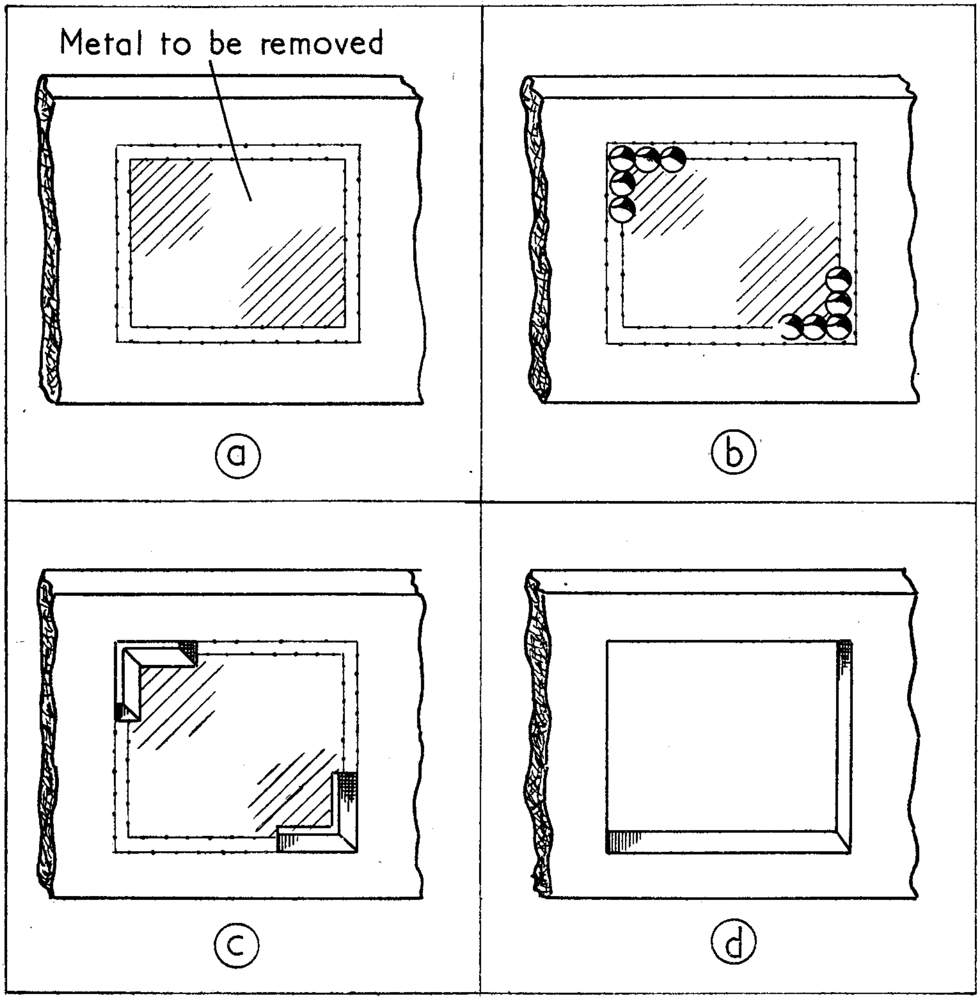


Fig. 6. Cutting an internal profile

as a precaution against damage when the saw breaks through. If the holes forming the radii are large, pieces of hardwood will make suitable plugs ; for small holes, as previously explained, brass plugs should be used. Finally, the profile is formed by accurately filing to the scribed lines. Where internal profiles are of some considerable length, the method just described is hardly the best as it involves a great deal more sawing than is necessary, so it is clearly desirable to make a machine do most of the work, if possible. Therefore, the material should be marked-off as already shown in Fig. 6 (*B*), so that a series of holes may be drilled all round the profile, thus removing the bulk of the metal. A small Eclipse 6 in. × ½ in. sawblade is then used to cut through the metal joining the drilled holes, after which the profile is filed to shape. Internal profiles which are either irregular or curved can only be cut in this way, unless resort is had to fretsawing, a method only to be recommended for thin material.

It is sometimes necessary to make cuts of greater length than the saw frame will accommodate with the blade mounted in the vertical position.

Good quality hacksaw frames have provision for overcoming this difficulty by allowing the blade to be turned through 90 deg. in the frame The work is then gripped horizontally in the vice with the frame held vertically and the cut is made in the manner illustrated in Fig. 8.

When using the hacksaw, the following rules should be observed :—

1. The pitch of the saw blade, that is the number of teeth in one inch of its length, should be such that the chips will clear easily. Thus, for mild steel, which has a curled chip, the pitch should be relatively coarse, say 18-24, but for brass a pitch of 24 or 32 will give free cutting.

2. Unless two or more teeth are in contact with the work at all times, there is every likelihood that the blade will suffer damage by the teeth being broken. Use a blade, therefore, with a

pitch that will ensure ample contact between the teeth and the work.

3. When fitting the blade to the frame see that it is strained to give a high-pitched note when plucked with the finger nail.

sufficient pressure on the forward stroke to ensure that the teeth bite into the work and so not merely slide over its surface; this pressure must be relieved on the backward stroke to avoid unnecessary wear of the teeth.

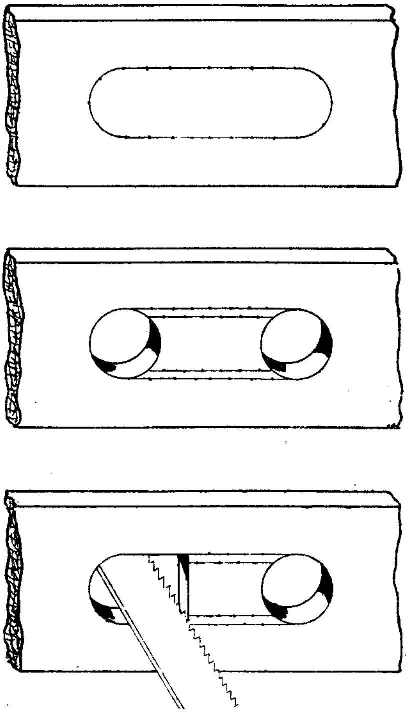


Fig. 7. Above—A; centre—B; below—C. Cutting an internal profile with radial ends

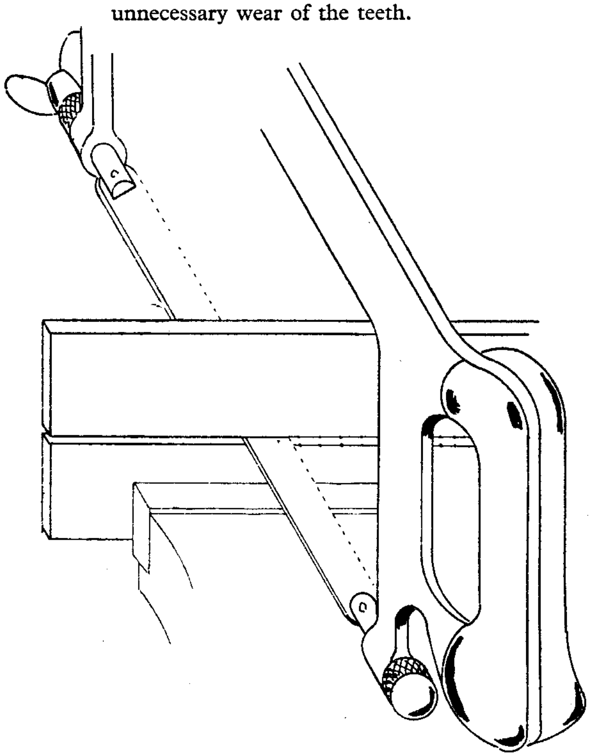


Fig. 8. Sawing with the blade at right-angles to the frame

4. Make sure that the saw blade is correctly aligned after it has been strained in the frame. This can be estimated by sighting the line of the blade against the back of the saw frame. A twisted blade will not saw straight.

5. Do not force the cut, but saw steadily from 50-60 strokes per minute. At all times maintain

6. If the blade breaks, do not attempt to start the new blade in the original kerf. Start again on the opposite side of the work.

7. As the set of the teeth becomes worn, the blade may tend to bind in the work; a little oil applied to the teeth with a brush will then ensure free working.

Twin Sisters

(*Continued from page* 148)

The whole idea of having three high pressure cylinders, set, of course, at 120 degrees, and with the fixed valve setting, is to provide an *engine equivalent of a reducing-valve*, without which it would not be possible to calculate a constant effective working scale for the two outside, medium-size cylinders.

There is absolutely no doubt that, for given prime steam pressure coupled with transfer steam pressure maintained in proportion, that multi-cylinder engines can utilise far more of the energy imparted, even if this multiplicity does tend to promote wheel slip.

It is common knowledge that most of the four-cylinder, eight-beats-to-the-bar type of engines were more given to wheel slipping than with any arrangement of four-cylinder compound engine ever produced.

In the same way, but with a different application, over porting can be just as bad as under porting, especially where compound working is concerned. In this connection, I was delighted to read Mr. K. N. Harris's article of June 30th last year, because his presentation of the valve ports proportions relative to efficient working, makes accurate and commonsense reading.

(*To be continued*)

Further Notes on Legal Liability

by "Lex"

THE information and views given regarding the liability for accidents in connection with models (see the article on "Legal Liability and Passenger Tracks" in the April 28th, 1949, issue of THE MODEL ENGINEER) seems to have aroused some interest, and it has been suggested that some points in connection therewith could do with further elucidation.

Of course, it is impossible to cover every circumstance that may arise. Each particular case must be judged on its own merits, and its own facts, but a general treatment of some of the situations more commonly arising will, it is felt, be useful.

First of all, it should be made clear that, in many cases, a person who has suffered damage may have an option as to whether to sue the society involved, or the individual causing the damage. So if a driver on a society's track negligently lets his water get low in the boiler, and an explosion or an escape of steam occurs, and injures a passenger, that passenger may sue the club—whose agent the driver is—or the driver himself, or, indeed, both jointly. So also in any case where the damage is caused by the neglect or default of some agent of the club—and agent has a very wide meaning here—the claimant may sue both the club and the member.

Of course, as was previously mentioned, at law, the liability of a club is usually, in the long run, the liability of each and all of its members But here, I am referring to an additional and personal liability, which the member is under, and for which he may or may not be able to claim against his fellow members. For if, in fact, both the club as a whole, and a member as an individual, are found liable for damages, the court can decide the proportions of blame attaching to each, and the proportion of the damages that each should have.

Now, in the normal case, the claimant would, as a matter of course, proceed against the club, for the individual member might be able to show that, in fact, the responsibility for the accident was not within his department, but attached to some other member. As the other member would also be the club's agent, this would not affect the club's liability, and would not give the club a defence. But, in the event of the club involved being a limited liability company, a fact which the claimant would soon discover, he, or his solicitor, would consider very carefully how far any judgment against the company would be worth anything, and if, in fact, there was doubt as to the company's means, a cautious solicitor would join any persons involved as co-defendants. So while the formation of a limited liability company does, in fact, relieve the club itself of certain risks, it may have an exactly contrary effect as regards some members.

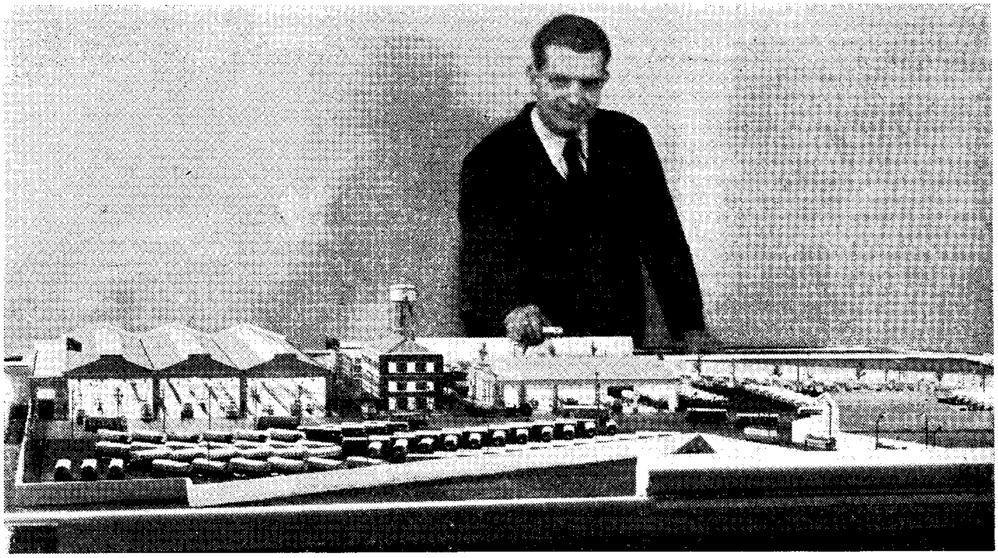
Another point to be remembered in connection with this is that, while an ordinary club is the aggregate of its members, and an insurance policy protecting the club from liability protects its members also, this is not the case as regards a company which is a separate legal entity. Care should, therefore, be taken in effecting insurance cover to see that not only the company, but the members are protected.

It will probably be asked in what case a member can be made liable separately and individually, for an accident arising in the course of a club function whether run by a members' club or a "company club." This is a hard question to answer briefly, and at the same time, fully. But it may be said that if damage arises from an act or omission which a reasonable man would have foreseen was likely to cause such damage, then the member responsible for that act or omission is liable. To give a few examples, a reasonable man would foresee that if the buffer stops were not properly fixed, or the track properly erected, damage may ensue. If I am fixing the stops, or erecting the track, and do not do it properly, I am liable. If I inspect and approve the track in a defective condition, I am liable. But if, not being in any position of authority and not being engaged in the running of the track, notice the defect, I am not liable—even though I do nothing about it. I am then not in a position of "responsibility" and I am entitled to assume—as regards my personal liability—that the responsible persons know what they are about. Again, a reasonable man knows that the brakes must be applied to stop the train. If I am driving, and neglect to apply the brakes, so that damage results, I am liable. But a member is not liable for failing to exercise a skill he does not, in fact, possess. If I, in fact, apply the brakes, but too late, or too sharply, then the question arises whether I was negligent or merely unskilled. A skilled driver may thus be held liable for an accident for which an unskilled man would be legally blameless.

And here, it should be noted that the liability exists not only to visitors and strangers, but also to fellow members of a club. It is, too, not confined to positive and present acts or omissions. A construction of a model may be such that a reasonable man might foresee that damage would arise. A fast model boat with a hot exhaust pipe running exposed through a cockpit may be expected to injure the hands of a stopper, if not warned. A sharp edge of metal on a locomotive may be expected to cut a person handling it, but a reasonable person would not expect a hitherto satisfactory throttle to jam open or a previously tested boiler to burst. It is, therefore, all a question of what a reasonable man, having the skill and knowledge of the member involved would, in fact, foresee.

It should be stressed once more that, in this article, I am dealing with the responsibility of the individual member, not of the society. The society's position was dealt with previously, and

(*Continued on next page*)



A Model Bus Depot

by A. W. Smith

THIS is a 1-in-25 scale model of one of the tram and bus depots in Lisbon, made for the Portuguese Industries Exhibition.

All the buildings are made of wood and painted in their true colours, even to each individual brick. All vehicles—of which there are 30 trams and 150 buses—are aluminium castings from wooden patterns and all hand painted, as well as all other vehicles, personnel, fire hydrants and breakdown lorry.

The respective buildings are, from left to right :—

(*a*) Tram car depot with pits to all lines and one illuminated (please note the man in front of the tram in the middle bay, as well as fire hydrants and hose boxes on the pillars). The four small squares over each bay are the track numbers.

(*b*) Traffic offices building, behind which is a building with two residences and the medical section, and farther back a third building which is the electrical sub-station. These are red brick buildings and the reproduction of the outside is a work of art.

(*c*) Bus service station, with the breakdown lorry in front and three buses being serviced and headed for the opening at the other end which has a roller shutter that really goes up and down. The roof of this station is noteworthy in that it has north lights incorporated in the beams and there are no columns inside.

(*d*) On the extreme right is the washing and re-fuelling station from whence can be seen emerging a double-decker.

(*e*) The water tower in the background is for general supply and fire-fighting reserve, and is equipped with access ladder and level indicator.

The model was built entirely by men at the depot in about six weeks. Each building is electrically illuminated and supplied by a blower with air for cooling purposes, and can be taken off the base by just lifting it in case of inspection or adjustment.

The overhead is of copper wire and galvanised for the span wires, all slung on poles made up of three different diameters of wire set up in their correct positions and to scale. The fire-alarm bell can be seen on the third pole from the extreme left ; there is a small van in the bus service station (immediately behind the breakdown lorry) and the railings around the sunken workshop can easily be seen beyond.

I am sure the photograph will be of interest to all model engineers. I am an assiduous reader of *The Model Engineer*, and am in my seventh year of building an " Iris " which is almost finished.

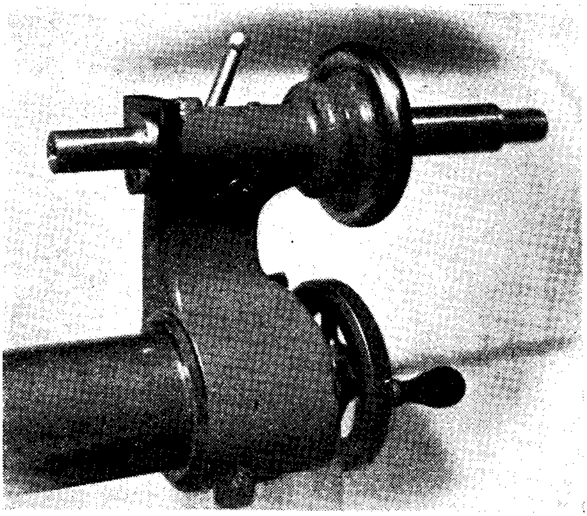
Further Notes on Legal Liability

(*Continued from previous page*)

it must be distinguished from that of the member. If the society is running a function it is responsible for the whole function, the member is responsible only for the part of the function with which he is entrusted. So the society's responsibility covers a much wider field than the member's. But, in some respects, the member's responsibility, though narrower, is deeper. He may be responsible to his fellow members, who, as part of the society, cannot claim against it. The two liabilities are, in fact, quite distinct, though they may well arise from the same circumstances.

Variations on an Old Theme

by H. T. Trotman

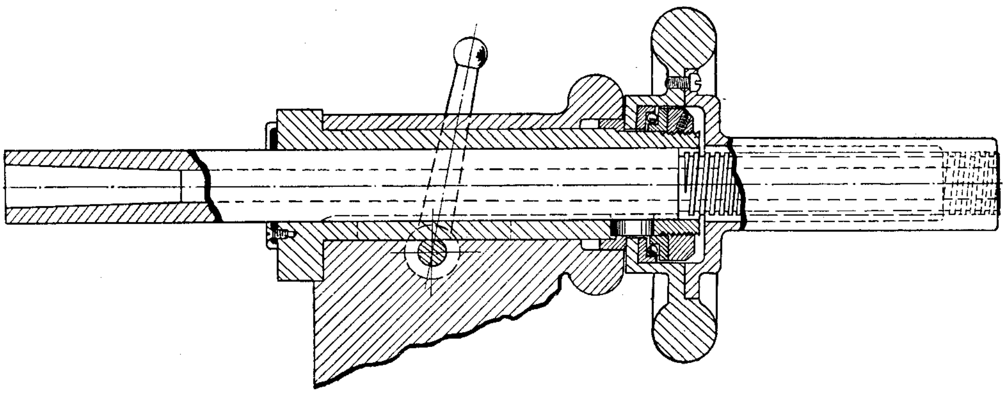


THIS is the story of the reconstruction of a tailstock. Round about 1920, the writer bought his first lathe, a second-hand Drummond round bed from Buck & Ryan. This was the early type with white metal lining to the tailstock barrel. Time had left its mark, so the main casting was bored out and a lever-operated centre put in place.

It was used in this form for some years, the only fault being a tendency to slacken when doing centre work. At long last, it was decided to return to the handwheel type, but with a difference. When a normal tailstock barrel is fully advanced, there is, usually, little support left, but with the new arrangement a glance at the sectional drawing will reveal how support is maintained throughout the length of the barrel movement.

The reader may have concluded, and rightly, that I have a great dislike of unprotected slides, and for that reason the saddle always carries a leather apron which will crumple up when brought close to the headstock. This feature can be recommended, for it saves a lot of cleaning.

A word now on details. The barrel is made from an old car axle, turned and bored on the lathe, for which it is intended, the temporary back centre being supported for this operation



in a three-point steady—a most useful accessory. Incidentally, the boring was done from one end only. It was started with a ¼-in. drill with an extended shank and was run in to the end of the flutes. The hole was then opened out with a 11/32-in. drill. By using these drills alternately it was possible to drill the 12-in. long hole without binding. The second drill was a diamond point with a reduced shank which gave ample room for cuttings. A ⅜-in. D-bit finished the bore, and this operation took plenty of patience, for it had to be repeatedly withdrawn to clear the accumulated swarf.

The barrel itself is made longer than is usual and the handwheel nut is formed on the end of a projecting boss, the length being equal to the screw travel. The barrel sleeve is slit for about two inches underneath, so that the clamp-bolt pressing on this will lock the barrel. The next feature of interest is the ball thrust race which also carries the weight of the handwheel. The negligible thrust occasioned by withdrawing the barrel is taken by a plain mild-steel ring, which also performs the duty of keeping the hardened key in position. It will be noted that the keyway never protrudes at the front end where a lubricating pad is fitted.

Owing to the limited travel available, the drills

were clamped in a vee-block on the saddle and fed in a short distance at a time, thus completing the bore by stages. To increase the bed length, the existing end leg was discarded, and a plate substituted just in front of the leadscrew handwheel, thus giving another two inches between centres.

The barrel sleeve is an iron casting, rough turned and bored, and allowed to stand for a while just in case of any "creep." It was then finished, turned and lapped in the bore.

The tailstock body itself calls for some comment. The first operation was the boring of the tangential clamp-bolt hole. This was done by mounting the casting on the cross-slide by means of a bolt passing through the main bore. It was then centred, drilled, and finally bored by means of a single point tool held in the chuck. After this the tailstock was replaced on the bed in readiness for cleaning out the main bore. The clamp-bolt pads were placed in the cross hole, and locked so that the whole assembly could be machined at one setting. The boring bar was held in the chuck and supported by the 3-point steady at the extreme end of the bed. Next, the tailstock clamp was tightened sufficiently so that the tailstock itself could be just pushed along when the saddle was traversed against it. In this manner the cut was applied and the bore skimmed out.

The handwheel (cast-iron) and nut extension (gunmetal) call for no special comment. Races are of mild-steel and case-hardened.

The whole assembly works very sweetly, and as the barrel is a lapped fit, there is no deflection when locked. It may be thought that this is a lot of work for one part of an old lathe, but it must be mentioned that there is plenty of "meat" in this machine and justified the work involved.

PRACTICAL LETTERS

Cylinder Steam Passages

DEAR SIR,—Surely the matter of port sizes is, and always has been, a case of compromise and the most suitable relationship between steam and exhaust ways and piston area was settled years ago in full-size practice to judge by the way all locomotives using both slide- and piston-valves from say 40 years ago up to the present time, fall into line within very narrow limits.

In round figures steam ports seem to be 1/10 of the piston area, exhaust ports and passageways to where they start to reduce for the blastpipe 1/5 of the piston area, and the actual blastpipe orifice about 1/12.

In a model, another factor enters into the compromise, namely, ease of construction; if this means drilled holes for ports and small exhaust ways, and therefore a blast orifice of 1/30-1/40 of the piston area, let us recognise this factor in its own right, but not make any claims for increased efficiency. After all, economy is not a very important factor in a model, and locomotive-type boilers can produce an enormous quantity of steam when pushed.

Nevertheless, anyone who has driven a model locomotive with these items in the same proportion as full-size and having long valve-travel, will have been astonished at the power available with cut-offs as early as 20 per cent. together with the almost inaudible exhaust and nearly black fire and very small water consumption, and equally delighted with the acceleration in full gear, and the accompanying clear deep "chuff," instead of the more usual "shish."

At 20 per cent. cut-off with the small ports, etc., very little power would be developed, as, in the first place, it is doubtful whether anything like boiler pressure could be built up behind the piston in the minute period the valve is open; but, more important, when the steam has expanded to five times its volume at the end of the stroke, most of the power resulting from the expansion would be used up in recompressing the steam to squeeze it out again through the tiny ports and exhaust ways.

I would point out that steam ports of this size on their own could be more wasteful of steam than small ones—the area right up to the blast nozzle must be adequate to cope with the large volume of expanded steam, and there must be no sharp corners. Long laps are also essential so that the exhaust ports shall remain open for as long a period as possible.

Yours faithfully.

Huddersfield. J. M. CROWTHER.

DEAR SIR,—I feel that I must butt in on this question of steam passages in cylinders. Some folk advocate a few drilled holes, whilst others maintain that they must be larger, or at least as large, as the ports. I have given the matter a good deal of thought, and have come to the conclusion that, in full-sized locomotives, the large passages are correct, but in small ones, such as 5-in. gauge and smaller, the small drilled passages are correct.

This may sound contradictory, but let me explain. Assume that we have a cylinder 18 in. bore × 2 ft. stroke; the steam passages are 2 in. × 16 in. in cross-section. We make a quarter-size model of this cylinder. It now measures $4\frac{1}{2}$ in. bore × 6 in. stroke. If our mathematical friends like to work that out, I think they will find that the volume of the smaller cylinder is 1/64 of the larger one. This means that the steam passages have only got to pass 1/64 the quantity of steam in the same length of time; so, surely the steam passages need to be only 1/64 of the cross-sectional area of the larger cylinder.

But if we scale down the dimension, making them $\frac{1}{2}$ in. × 4 in. we find that they are 1/16 smaller which is four times the area necessary.

To make them 1/64 the size, they would be 1 in. × $\frac{1}{2}$ in., quite a considerable difference. If we reduce the size still more to make a 1 in. scale cylinder, it will be $1\frac{1}{2}$ in. × 2 in., which reduces the volume to 1/27 of the quarter-full-size one. To make the steam passages 1/27 of the cross-sectional area they would be $\frac{1}{2}$ in. × 1/27 in. of 1/6 in. × 1/9 in., which is equal to one 5/32 in. diameter hole approximately. So it seems that

the four 5/32-in. diameter holes as specified by "L.B.S.C." in his 5-in. gauge cylinders is ample.

Yours faithfully,
Romford. H. STUTTLE.

DEAR SIR,—As the maker of a locomotive that seems to be arousing a good deal of discussion in the correspondence columns, and as several people seem to be rushing into print without fully thinking out their remarks, may I be permitted to join in? Anyone who has read my original article will recollect that I gave the ratios of all the areas through the steam line; there is nothing very excessive about any of them, but they all bore a definite relation to each other and were arrived at after a long course of experiments, and the results were certainly good, although I say it. I should be very pleased to let any responsible and interested person try my 0-6-0. I ran it myself a little time ago after its long rest during the war years, and was rather astounded at its performance.

Why all this yelping about cavernous passages? They are not so. And straight slide gears? The gear on this engine gives a more perfect distribution both theoretically and practically than the standard Joy.

If I may just criticise one letter that has appeared, Mr. N. Scrouther claims to be a qualified steam engineer, yet he enlarged the steam passages of "L.B.S.C.'s" "Annie Boddie" to a section of 1/8 of the piston area; did he not work out the piston speed first? "L.B.S.C." stipulated passages of an area of 1/14 that of the piston; my 0-6-0 mentioned above has a passage area fractionally greater than 1/13. I would add that the passage area of Chapelon's 4-8-0 is: high-pressure, 1/6, and low-pressure, 1/8; that on an engine with twenty times the piston speed. His remarks about carboned-up passages are difficult to understand; if he worked in the shops, surely he knows how an engine with carboned-up passages runs.

Yours faithfully,
Bexhill-on-Sea. C. M. KEILLER, M.I.Mech.E.

Feed Pump Design

DEAR SIR,—I am afraid the method of feed-pump design described by Dr. Fletcher in his letter is likely to prove very unreliable; I suggest that the fact that it worked on his boiler only proves that he was remarkably lucky, and errors cancelled out. Even on a full-size job one would not dream of allowing such a small margin for error as 10 per cent.

A minor point is that the statement "the molecular weight of any substance in gaseous form occupies a volume of 22,400 c.c." is only true if for the words "in gaseous form" we substitute "in the state of a *perfect gas*," which is by no means true of steam. Hence the necessity of calculating and using steam tables. At 60 lb./sq. in. the discrepancy is only about 5 per cent. if the steam is perfectly dry (which it won't be by the time it gets into the cylinder unless it starts with considerable superheat).

Again, the statement that because the cylinder of a double-acting engine has to be filled twice per revolution the volume required is $2\pi r^2 \times L$ is an over-estimate, unless the valve does not cut off until the end of the stroke. The volume should, of course, be the volume at cut-off, including the "clearance" at the end of the cylinder and in the passages (or else why work steam expansively?)

These things can, of course, be calculated, but it is scarcely worth while because there is an enormous, and quite unknown, error, the "missing quantity." In his book, *The Steam Engine*, Sir Alfred Ewing devotes a chapter to this; which may be summarised as the unfortunate fact that the quantity of steam actually found necessary is always greater than that calculated, even after making allowance for clearance-volume. It is partly due to leakage past the valve from steam to exhaust side, but a very much greater cause of this error is that owing to the cylinder cooling during the exhaust stroke, it is much colder than the entering steam, which therefore condenses on the cylinder walls. (The "Uniflow" engine is a successful attempt to reduce, though it cannot entirely eliminate, this condensation.) It is stated that this "missing quantity" or excess of steam actually used over that calculated, is rarely less than 20 per cent., sometimes as much as 50 per cent., and that 69 per cent. was actually measured on a "small" engine (presumably at least several horsepower). On a model one would expect the condensation to be much greater, since as "L.B.S.C." wisely reminds us from time to time, "You can't scale Nature." A model to the linear scale of one-tenth full size has one thousandth the cubic capacity of cylinder, but one hundredth the cooling surface, as compared with the prototype; the cooling surface in relation to the volume is therefore ten times as much in the model as in the prototype.

I should not like to hazard a guess as to the magnitude of the missing quantity in a model, but I should be surprised if, without superheat, it were *less* that four times the calculated value. Superheating the steam can, and does, reduce the missing quantity, as long as the degree of superheat is enough to ensure that the steam is really dry *in the cylinder at the point of cut-off*; in anything of model size, there is probably little to be gained by more superheat than is needed to ensure this, Would "L.B.S.C." agree with this? At any rate, *one* of the many reasons why his engines do such an amazing amount of work per pound of steam is, must be, that he avoids this condensation waste of good steam by superheating.

I have never seen figures of actual and calculated steam consumption for a model, if any readers have actual measurements it is to be hoped they will be published in THE MODEL ENGINEER.

Yours faithfully,
"NUMERATOR."

An Old Plough Engine

DEAR SIR,—Your readers may like to know that according to a letter in the *Farmers' Weekly* of October 21st, 1949, a single engine steam ploughing outfit is still at work at Mr. P. Checksfield's Eaton Farm, Burmarsh, Kent. The engine bears the nameplate J. & H. McLaren, Leeds and is reputed to be nearly 70 years old.

Yours sincerely,
London, S.E.26. E. M. ACKERY

Modern Locomotive Design

DEAR SIR,—I was much heartened by Mr. K. N. Harris's letter in the November 17th issue. From my own modest observations, together with reports of which the authenticity cannot be disputed, I can fully endorse Mr. Harris's statement as to the efficiency of the Bulleid designs; the "Pacifics" particularly, are capable of all that is asked of them without fully extending their powers; and it is surely significant that much of their present day work with heavy trains is accomplished with time in hand, and but fractional regulator openings.

However, I think that the main point of Mr. Harris's letter was not entirely in defence of the designs in question, but equally against certain ill-considered statements which sometimes find their way into these pages, and in this I heartily agree with Mr. Harris's point of view.

An old axiom has it, that, "It is easier to be critical than correct," and in respect of this philosophy it is logical to temper one's comments, constructive or destructive, with due qualifications; sentimental attachments and personal bias should not influence matter intended for the consumption of those interested in mechanical engineering, especially as a hobby, and whose devotees might not have had the advantage of a mechanical training.

It is as well to recognise that the post of Chief Mechanical Engineer is a highly responsible one, involving many years of concentrated study from the theoretical and practical aspect, together with more than average ability at that. We find too, almost without exception, that men in this position invariably refer to the inspiration derived from the work of past and contemporary engineers in their creations. If we pause to consider that such men of brilliance can make modest acknowledgement in this manner, we will surely refrain from making absurd generalisations as those referred to in Mr. Mr. Harris's forthright letter.

Yours faithfully,

Winchester. F. ARTHUR HOLLAND.

CLUB ANNOUNCEMENTS

Cardiff and District Society of Model and Experimental Engineers

It has been arranged, at very short notice, that the above society will hold an exhibition on February 8th, 9th 10th and 11th next, at Wood Street Schools, Cardiff. This will be our biggest effort in exhibitions so far.

Hon. Secretary: F. W. JONES, Aucuba Lodge, Tyrwinch Road, St. Mellons, Mon.

Sutton Model Engineering Club

The annual dinner and social evening will be held at Wilson's Cafe, Grove Road, Sutton, on Saturday, March 4th. 6.30 p.m. for 7 p.m.

Easter Monday. Club locomotive rally and competition.

Annual General Meeting. Thursday, May 4th, 8 p.m., at Garden Hall, Sutton.

Hon. Secretary: P. G. JOHNSTON, 9, Stanley Road, Sutton, Surrey. Phone: Vigilant 1150.

Huddersfield Society of Model Engineers

The following dates have been fixed for events:—

February 15th. Lecture on "Heat Treatment of Metals," by H. Smith.

March 16th. Talk, with illustrations, on "The Romance of Railway History," by W. Stocks.

April 19th. Lecture on "Model Yachts," by A. Arnold, of Leeds.

Secretary: F. W. L. BOTTOMLEY, 763, Manchester Road, Huddersfield.

Southend-on-Sea Model Power Boat Club

This club is now affiliated to the M.P.B.A.

It is intended to run a competition for radio-controlled boats in the near future; any enthusiasts interested should get into touch with the Hon. Secretary, J. HARRISON, 10, Broadclyst Gardens, Thorpe Bay, Essex.

Nottingham Society of Model and Experimental Engineers

The above society are holding their annual exhibition from March 29th to April 1st inclusive. We shall be holding an open competition with prizes of five guineas, three guineas and two guineas, and we invite all model makers to have a go.

We cordially invite all model makers with interesting or outstanding models to loan them for exhibition. This is our 21st anniversary year and we would like to make the exhibition befitting of the occasion.

The exhibition will be held at the Victoria Baths, Bath Street, Nottingham. Opening times are 2 p.m. till 9 p.m. weekdays, and 11 a.m. till 9 p.m. Saturday.

Full particulars and entry forms, etc., may be had from the Secretary, E. S. WRIGHT, 186, Wilford Road, Nottingham.

Harrow and Wembley Society of Model Engineers

The annual general meeting was held on Wednesday, January 11th, at Heathfield School, College Road, Harrow. Mr. C. R. Jeffries, the society's chairman, summarised the activities of the club during the past year and praised the committee for its high attendance at meetings, and its work in organising club events. Finally, he proposed a vote of thanks to the two committee members who are retiring this year; Mr. S. R. Emery, for very long service to the society generally and recently, as marine section steward: and to Mr. C. R. Fox, for his untiring work in a great variety of club activities, notably that of exhibition secretary.

After the election of officers for the new season, members were invited to express their wishes regarding the future programme of the society and suggestions for visits were called for. The meeting closed informally.

Hon. Secretary: J. H. SUMMERS, 34, Hillside Gardens, Northwood, Middx.

Taunton and District Society of Model and Experimental Engineers

At a special meeting of members held at the clubroom, on New Year's Eve, the following officials were elected: president, Colonel R. H. Logan; vice-president, Mr. F. G. Bettles; chairman, Mr. J. Gardner; vice-chairman, Mr. G. Payne; hon. secretary-treasurer, Mr. C. A. Lindner; assistant hon. secretary, Mr. E. H. Curry.

It is hoped that more members will bring along their work to enter in the Logan Tate Cup competition, which does not close until April 22nd.

Hon. Treasurer and Secretary: C. A. LINDNER, St. Crispin, Trull Road, Taunton. Phone 4004.

London Electricity Sports and Social Association (Model Engineering Section)

A model engineering section has been organised and is now firmly established. Excellent workshop facilities including the services of a skilled instructor, and meeting rooms are available at the Beaufoy Institute, Black Prince Road, S.E.11, for the use of members. Section meetings are held every Wednesday but the workshops are available any night of the week from 6.30-9.30 p.m.

Railway interest is represented from "OO" gauge upwards (several $3\frac{1}{2}$-in. gauge locomotives are being built and others are planned for early construction), together with model boats, aeroplanes and all forms of engineering in miniature.

Interested or intending members should contact the Acting Hon. Secretary, S. L. G. CARDNELL, British Electricity Authority, Group 1 Headquarters, Barnes, or attend any Wednesday evening at the Beaufoy Institute.